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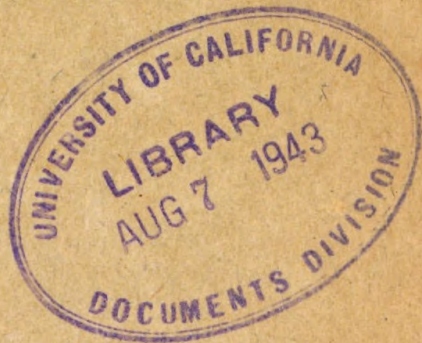
**TM 1-460**

**WAR DEPARTMENT**

**TECHNICAL MANUAL**

**ARMY AIR FORCES**  
**RADIOTELEPHONE PROCEDURE**

**March 20, 1943**





What will  
you  
have

10/18

**TECHNICAL MANUAL**  
**ARMY AIR FORCES**  
**RADIOTELEPHONE PROCEDURE**

CHANGES  
No. 1

U. S. WAR DEPARTMENT  
WASHINGTON 25, D. C., 11 October 1945

TM 1-460, 20 March 1943, is changed as follows:

10. Radio call signs.—a. *Ground stations.*

\* \* \* \* \*

(2) Army Airways Stations (AACS) will be designated by the name of the field at which they are located, plus the word "Airways." Example: "Scott Airways," "Chanute Airways."

\* \* \* \* \*

b. *Airplanes.*—Airplane call signs \* \* \* ship to ship. Example of tactical airplane calling range station at St. Louis:

"St. Louis Radio, this is Able Seven Peter (A7P), over."

Example of Airways control station using plane's tactical call:

"Niner Queen Jig (9QJ), this is Scott Airways, over."

[AG 300.7 (3 Oct 45)]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:

EDWARD F. WITSELL

*Major General*

*Acting The Adjutant General*

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*Chief of Staff*

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AF (5); AAF Comds (5); W (5); G (3); S (3); BU (3).





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TM 1-460  
1943  
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TECHNICAL MANUAL }  
No. 1-460 }

WAR DEPARTMENT,  
WASHINGTON, March 20, 1943.

## RADIOTELEPHONE PROCEDURE

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\*This manual supersedes TM 1-460, March 31, 1942.

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## SECTION 1

## GENERAL

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**1. General.**—*a.* The purpose of this manual is to acquaint radio operators and pilots of the Army Air Forces with radiotelephone procedure. The procedure herein is sufficient for satisfactory voice communication with the various radio services that the radio operator or pilot may wish to contact. The radiotelephone (R/T) procedure prescribed in FM 24-9 is included.

*b.* Such items as weather reports, facility charts, radio ranges, etc., though they cannot be called procedure, are nevertheless necessary in order that the radio operator in flight may be sufficiently familiar with these items so as to provide satisfactory communication service.

*c.* A section is devoted to airport control tower procedure (sec. IV). This is included in order to familiarize enlisted men with such procedure in case they are detailed to duty as airport control tower operators. It also serves as a guide for pilots who may wish to review control tower procedure.

**2. Instructions for communication operators.**—Much of the time, voice communication in the Army Air Forces is necessarily



complicated by operational noise. Conditions in a flying aircraft do not compare favorably with those in a radio broadcasting studio where elaborate precautions are taken to insure audibility and exclude outside noise. Intelligibility under operating conditions requires the most efficient possible use of the radio equipment, the voice of the speaker, and the ear of the listener.

*a. Hand-held microphones* should be held directly in front of the mouth, (that is, so the operator speaks into the microphone rather than across it) and as close to the mouth as possible without interfering with the movement of the lips. The microphone should actually touch the lips lightly. At this point the voice is loudest; and the operator's face cuts off some at least of the competing noise.

*b. Throat microphones* should be worn so that the two buttons straddle the "Adam's apple," with the strap adjusted tightly enough to be just short of uncomfortable. A slight displacement of the buttons from the correct position, or the least slackness in the straps will markedly lower the intelligibility of the signal.

*c. Use of earphones ("receivers").*—The receiver should be worn so that the center of the earphone is directly over the ear passage. The phone is in proper position when a finger pressed against it is felt on all sides of the ear passage. The earphone cup should fit closely to the skin all the way around the ear. Test it by running a finger around the cup. If earphones are worn in headbands the sliding rod should be adjusted carefully. If the seal is not tight, especially under the lobe of the ear, it may be made tight by bending the metal straps of the headband inward. When earphones are worn in helmets the chin strap should be kept fastened while listening to messages. Headset or helmet should never be removed when in flight. Even when not in use for communication the earphones protect the ears from the deafening effect of engine noise.

**3. Enunciation.**—Thorough tests have shown that the advice, often given formerly, to use a normal tone in speaking into the microphone, is wholly wrong. The voice should be raised as much as possible without straining or distorting it. To be clearly intelligible, the spoken sound must be louder at the face of the microphone than surrounding noises. The amplifier will raise the voice level, but only to the same degree that it raises all other sound reaching it. It remains up to the speaker to make his voice the loudest of those sounds. Speech should be as distinct as possible. Normal pronunciation should not be distorted, but within that limit every sound of every word should be emphasized, without "er's" or "uh's" between words. In speaking a complete sentence, use the natural sentence-rhythm and intonation, but *do not drop the voice.*

**4. Speech rate.**—Radiotelephone transmissions will be performed at a rate which if necessary will permit the receiving operator to copy the transmission verbatim. Stations of the Civil Aeronautics Administration (CAA) transmit scheduled broadcasts at a rate of 120 words per minute.

**5. Superfluous transmissions.**—A radio frequency channel is equivalent to a telephone in many respects but is more susceptible to interference and enemy interception. Unnecessary transmissions will be avoided in order to minimize those possibilities. Radiotelephone transmissions will be made in a concise and businesslike manner and in a normal conversational tone of voice without undue fluctuation. Only official transmissions will be made. Operators will refrain from personal remarks which have no bearing on the message or messages being transmitted.

**6. Phonetic alphabet.**—When necessary to identify any letter of the alphabet the standard phonetic alphabet is to be used. This alphabet is listed below:

Letter	Spoken as—	Letter	Spoken as—
A	ABLE (AFIRM)*	N	NAN (NEGAT)*
B	BAKER	O	OBOE (OPTION)*
C	CHARLIE	P	PETER (PREP)*
D	DOG	Q	QUEEN
E	EASY	R	ROGER
F	FOX	S	SUGAR
G	GEORGE	T	TARE
H	HOW	U	UNCLE
I	ITEM (INTERROGA- TORY)*	V	VICTOR
J	JIG	W	WILLIAM
K	KING	X	XRAY
L	LOVE	Y	YOKE
M	MIKE	Z	ZEBRA

\*Names in parentheses shall be used when the *United States Navy General Signal Book* is used.

### *Examples*

a. Encrypted groups—LUXOW will be spoken as “Love Uncle Xray Oboe William.”

b. Difficult words will be both spoken and spelled. Example: “Catenary—I spell—Charlie Able Tare Easy Nan Able Roger Yoke—Catenary.”

c. *Expression of time of origin and time in texts of messages.*—(1) Time of origin in messages for combined and joint United States



Army-Navy communications will be expressed as six figures, followed by a zone suffix letter from table following, the first pair of digits denoting the date, the second pair hours, the third pair minutes, except that the first two digits denoting the date may be omitted if not required. All times in the *text* of messages will be expressed with a zone suffix letter from the table except that in text of messages involving a large number of times a covering expression such as "all times zone Baker" may be used instead of appending a zone suffix letter to each. When reference is made to a message by its time of origin, the method of expression of that time of origin will be preserved in its original form. The month and year may be added if necessary.

*Example:* "Your 161412Z DEC 42."

The time of origin used in messages which cross time zones will be GCT (GMT) unless considerations of security or expediency require otherwise.

(2) Table of time zones, zone descriptions, and suffixes. (See restricted War Department Circular, dated March 15, 1943, unnumbered.)

**7. Pronunciation of numerals.**—When figures are transmitted by radiotelephone the following rules for their pronunciation will be observed:

Numeral	Spoken as—	Numeral	Spoken as—
0	ZE-RO	5	FI-YIV
1	WUN	6	SIX
2	TOO	7	SEVEN
3	THUH-REE	8	ATE
4	FO-WER	9	NINER

**8. Use of numerals.**—Numbers are transmitted as numerals or digits except in the case of an even hundred or thousand, when the word hundred or thousand is used. Examples:

Number	Spoken as—
44	FO-WER FO-WER
80	ATE ZE-RO
136	WUN THUH-REE SIX
500	FI-YIV HUN-DRED
1478	WUN FO-WER SEVEN ATE
7000	SEVEN THOW-ZAND
16000	WUN SIX THOW-ZAND

**9. Statement of time.**—*a.* Time will be stated in exactly four figures utilizing the 24-hour clock. The hour will be stated by the first two figures and the minutes by the last two figures. Midnight is 2400 of present day, or 0000 of following day. However, 2400 is seldom used. The last hour of the 24-hour clock day begins at 2300. The last minute of the last hour begins at 2359 and ends at 0000, which is the beginning of the first minute ending at 0001 of the first hour of the next day.

*b.* Examples of statement of time:

Time	Statement
0000 (midnight)-----	Zero zero zero zero
0920 (9:20 AM)-----	Zero nine two zero
1200 (noon)-----	One two zero zero
1643 (4:43 PM)-----	One six four three
2347 (11:47 PM)-----	Two three four seven

**10. Radio call signs.**—*a. Ground stations.*—Radiotelephone call signs for ground stations in nontactical operations will be designated by the field name plus the type of communication service being called.

(1) Control towers will be designated by the name of the field at which they are located, plus the word "tower." Example: "Scott tower," "Chanute tower," etc.

(2) Army Airways Stations (AACS) will be designated by the name of the field at which they are located, plus the words "Army Airways." Example: "Scott Army Airways," "Chanute Army Airways."

(3) Radio ranges will be designated by the name of the field at which they are located, plus the word "radio." Example: "Scott Radio," "Chanute Radio," "St. Louis Radio," etc.

In tactical operations the ground station will be designated by a tactical call sign or call word. The phonetic alphabet is used for any letters included in the call sign. (See pars. 11*a*, 14, 24, and 25 for examples.)

*b. Airplanes.*—Airplane call signs are composed of numbers, letters, words, or combinations of them. Each ship will have its call sign displayed near the radio position. Many army aircraft have the call sign painted on the microphone to avoid confusion when operators change from ship to ship. Example of tactical airplane calling range station at

St. Louis: "St. Louis radio from Able Seven Peter (A7P) over." Example of Airways control station using plane's tactical call: "Niner Queen Jig (9QJ) from Scott Army Airways, over."



**11. Component parts of a message.—a. Form.**—The call of a radiotelephone message may take one of the following forms:

<i>Case I—full call</i>		<i>Examples</i>
Call sign receiving station	This is	Able Baker
Call sign station calling		Peter Three
<i>Case II—abbreviated call</i>		<i>Examples</i>
This is	Call sign station calling	This is Peter Three
<i>Case III—link call*</i>		<i>Examples</i>
Link call sign		Able Baker Charlie

**b. Precedence.**—Precedence designations are seldom used in voice (R/T) procedure, but if used will be spoken in clear as the last part of the call. The terms in order of importance are:

1. Urgent
2. Operational Priority
3. Priority

### THE TEXT (subject matter)

The text (subject matter) may consist of plain language, code words, or figures. If it is necessary to spell out a word, the phonetic alphabet will be used.

### THE ENDING

Every transmission will end with one of the following procedure words:

<i>Word</i>	<i>Meaning</i>
a. Over	My transmission is ended and I expect a response from you.
b. Out	This conversation is ended and no response is expected.

#### *Example 1*

<i>Call</i>	Shamrock this is Domino.
<i>Text (subject matter)</i>	Where are tanks?
<i>Ending</i>	Over.

\*The link call sign procedure is a special arrangement not at present in general use. When prescribed for specific use further instructions will be issued.

*Example 2.*

*Call* Domino this is Shamrock.  
*Text (subject matter)* Tanks are at base.  
*Ending* Out.

**12. Time of origin.**—The time of origin when employed will be expressed as prescribed in paragraph 9 and will be preceded by the word "time." The four digits will, when so ordered, be followed by the zone suffix letter.

**13. Procedure phrases.**—It is inadvisable to lay down precise wording for all procedure phrases likely to be required in radiotelephone work. However, the following have been adopted:

<i>Word or phrase</i>	<i>Meaning</i>
Roger	"I have received all of your last transmission."
Acknowledge	Used by originator: "Let me know that you have received and understand this message."
Wilco	"Your last message (or message indicated) received, understood, and (where applicable) will be complied with."
How do you hear me?	
Speak slower	
Wait	If used by itself: "I must pause for a few seconds." If the pause is to be longer than a few seconds, "Wait" "Out" should be used. If "Wait" is used to prevent another station's transmitting, it must be followed by the ending "Out."
Say again	"Repeat."
I say again	"I will repeat."
Verify	"Check coding, check text (subject matter) with the originator and send correct version."
Message for you	"I wish to transmit a message to you."
Send your message	"I am ready for you to transmit."
Read back	"Repeat all of this message back to me exactly as received after I have given 'Over.'"
That is correct	"You are correct."
Words twice	a. <i>As a request.</i> —"Communication is difficult. Please send every phrase (or every code group) twice." b. <i>As information.</i> —"Since communication is difficult every phrase (or every code group) in this message will be sent twice."



<i>Word or phrase</i>	<i>Meaning</i>
Correction	"An error has been made in this transmission (or message indicated). The correct version is -----."
Wrong	"What you have just said is incorrect. The correct version is -----."
Groups	"The number of groups in this code or cipher message is -----."
Break	"I hereby indicate the separation of the text from other portions of the message." To be used only when there is no clear distinction between the text and other portions of the message.

**14. Transmitting and answering.**—The following general rules govern the transmission of radiotelephone (R/T) messages when two-way working is employed:

a. When both stations are in good communication, all parts of the transmission are made once through.

*Example*

Station AB wishes to transmit a message to station P3:

AB transmits:

Peter Three--This is--Able Baker--Message for you--  
Over.

P3 transmits:

Able Baker--This is--Peter Three--Send your message--  
Over

AB transmits:

Peter Three--This is--Able Baker--Convoy has arrived--Time 1630--Over.

P3 transmits:

Able Baker--This is--Peter Three--Roger--Out.

b. If an operator transmits a message without waiting for an answer to the preliminary call, the call sign(s) of the receiving station(s) will be transmitted twice, and may be repeated also at the end of the message.

*Example*

AB transmits:

Peter Three--Peter Three--This is--Able Baker--  
Convoy has arrived--etc.

c. When communication is difficult, phrases, words, or groups may be transmitted twice by use of the procedure phrase "words twice."

*Example***AB transmits:**

Peter Three--This is--Able Baker--Message for you--  
Over.

**P3 transmits:**

Able Baker--This is--Peter Three--words twice--Send  
your message--Over.

**AB transmits:**

Peter Three--This is--Able Baker--words twice--  
Convoy has arrived--Convoy has arrived--Time 1630  
--Time 1630--Over.

d. (1) If the message is to be repeated back the procedure phrase "Read back" will be used.

*Example***AB transmits:**

Peter Three--This is--Able Baker--Message for you--  
Over.

**P3 transmits:**

Able Baker--This is--Peter Three--Send your mes-  
sage--Over.

**AB transmits:**

Peter Three--This is--Able Baker--Read back--Con-  
voy has arrived--Time 1630--Over.

**P3 transmits:**

Able Baker--This is--Peter Three--Convoy has  
arrived--Time 1630--Over.

**AB transmits:**

Peter Three--This is--Able Baker--That is correct--  
Out.

(2) Particular instructions for certain occasions (such as fighter direction) may direct that a certain message, or portions thereof, automatically will be repeated back by the receiving station without using the procedure phrase "read back."

e. When no confusion will result, a shortened form of calling may be used. When only two stations are in a net, it often will be possible to omit all calls and most of the normal procedure.

*Examples*

*Call sign of calling station omitted:*

"Able Baker...Convoy has arrived...Over."

*Call sign of called station omitted:*

"This is Peter Three...Where are Tanks...Over."

In the interest of speed, special provision may be made by responsible commanders for special use of abbreviations of call signs, as for aircraft and tanks. Aircraft calling control towers, radio range stations, etc. (see pars. 65, 67, 97, and 101) will ordinarily use shortened forms.

**15. Code and cipher messages.**—In code or cipher messages the number of groups if sent will be preceded by the word "groups," immediately before the text (subject matter). Code words may be transmitted as plain language words; encoded or enciphered groups will be spelled phonetically.

**16. Repetitions.**—*a.* When words are missed or are doubtful, repetitions will be requested by the receiving station before receipting for the message. The procedure phrases "say again" and "I say again" used alone or in conjunction with "all before," and "all after," "..... to ....." and "word after" will be used for this purpose.

*b.* In giving repetitions, the transmitting station will always repeat the words used in the request to identify the portions.

**17. Correction of messages.**—*a. Correction during transmission.*—When an error has been made by a transmitting operator, the procedure word "correction" will be spoken, the last group or phrase sent correctly will be repeated, and the correct version then transmitted.

*Example*

Able Baker...This is...Peter Three...Victor One Zero One...  
Correction...Victor One Zero Zero...etc.

*b. Correction to a message being repeated back.*

*Example*

Peter Three...This is...Able Baker...Read Back...Convoy has arrived...Time 1630...Over.

Able Baker...This is...Peter Three...Convoy has arrived...  
Time 1640...Over.

Peter Three...This is...Able Baker...Wrong...Word after arrived...Time 1630...Over.

Able Baker...This is...Peter Three...Time 1630...Over.

Peter Three...This is...Able Baker...That is correct...Out.



**18. Acknowledgment of messages.**—"Wilco" shall be used in response to the procedure word "acknowledge" in the text of voice messages, or may be used to acknowledge receipt and capability to comply with an order received even though instructions to acknowledge were not included. *As the meaning of "Roger" is included in that of "Wilco," the two words are never used together.*

**19. Radiotelephone (R/T) executive method.**—When voice procedure is used for the executive method, the message shall be made *either as—*

*a.* A message, the purport of which is to be executed upon receipt of the executive word which is included in the same message,

*or*

*b.* A message, the purport of which is not to be executed until the receipt of the executive word which will be transmitted in a separate executive message (usually after the signal message has been receipted for). When necessary, the executive message must carry identification data to insure that the correct message is executed; normally this identification is the repetition of the text.

The *executive word* for United States services is "*Execute.*"

*Example a*

Domino this is Shamrock  
Execute to follow  
Break  
Charlie Baker Baker  
I say again  
Charlie Baker Baker  
Standby  
(pause)  
Execute

*Example b*

Domino this is Shamrock  
Execute to follow  
Break  
Charlie Baker Baker  
I say again  
Charlie Baker Baker  
Over

*Receipt(s) are procured as follows:*

Shamrock this is Domino  
Roger..Over  
Domino this is Shamrock  
Standby  
(pause)  
Execute

**20. Group working.**—When there are several stations working in a group, it may happen that a station other than the one called may not hear the transmission until it is half way through and so would not know whether the message were intended for it or not. To avoid confusion it might be advisable to repeat the call at the end of the transmission.

In net or group working, stations should answer in the alphabetical and numerical order of their call signs. When both alphabetical and numerical signs are in the net, the numerical calls should follow the alphabetical calls.

**21. Signal strength readability.**—*a.* A station is understood to have good readability unless otherwise notified. Except when making original contact, strength of signals and readability will not be exchanged unless one station cannot clearly hear another station.

*b.* The response to "How do you hear me" will be a short concise report of actual reception, such as "weak but readable," "strong but distorted," etc.

**22. Operating signals.**—In cases where operating signals would be applicable, the phraseology of the meaning attached to them or a shortened form will be used in radiotelephone (R/T) procedure.

**23. Authentication.**—Authentication of messages will be made in accordance with current instructions.

**24. Two-station net.**—In the following examples, a two-station net (one to one working) is assumed. The call signs of the stations are AWM and JFC.

*a. Establishing communication.*

JFC transmits:

Able William Mike..This is Jig Fox Charlie..How do you hear me..Over.

AWM transmits:

Jig Fox Charlie..This is Able William Mike..Okay..Over.

*b. Further communication at a later time.*

JFC transmits:

Able William Mike..Message for your..Over.

**AWM transmits:**

Send your message...Over.

**JFC transmits:**

Read back...Break...Adopt plan...STORK...I spell...  
Sugar...Tare...Oboe...Roger...Roger...Correction...Sugar...  
Tare...Oboe...Roger...King...two...three...five...nine...  
hours Time one...six...zero...zero...Over.

**AWM transmits:**

Adopt plan STORK...two...two...five...nine...hours Time  
one...six...zero...zero...Over.

**JFC transmits:**

Wrong...Word after STORK...two...three...five...nine...  
Over.

**AWM transmits:**

Two...three...five...nine...Over.

**JFC transmits:**

That is correct...Out.

**25. Four-station net.**—In the following examples a four-station net is assumed. The call signs are:

AWM...net control station (controlling station).

AB1...subordinate station.

AB2...subordinate station.

AB3...subordinate station.

XYZ...net call (collective call including station AWM, AB1, AB2 and AB3).

**AWM...has a message for all stations in the net.**

**AWM transmits:**

Xray Yoke Zebra...this is Able William Mike...Message  
for you...Over.

**AB1 transmits:**

This is Able Baker One...Send your message...Over.

**AB2 transmits:**

This is Able Baker Two...Send your message...Over.

**AB3 transmits:**

This is Able Baker Three...Send your message...Over.

**AWM transmits:**

Xray Yoke Zebra...Adopt plan...STORK...I spell...  
Sugar...Tare...Oboe...Roger...King...Two...Three...  
Five...Nine...hours...Time one...Seven...zero...zero...  
Over.

**AB1 transmits:**

This is One...Roger...Out.



**AB2 transmits:**

This is Two...Say Again...Words Twice...Over.

**AB3 transmits:**

This is Three...Say Again...Word After...STORK...  
Over.

**AWM transmits:**

Two and Three...I say again...Words twice...Adopt  
plan STORK...Adopt plan STORK...I spell...Sugar  
...Tare...Oboe...Roger...King...I spell...Sugar...  
Tare...Oboe...Roger...King...two...three...five...nine  
hours...two...three...five...nine hours...Time one...  
seven...zero...zero...Time one...seven...zero...zero...  
Over.

**AB2 transmits:**

This is Two...Roger...Out.

**AB3 transmits:**

This is Three...Roger...Out.

**Later the addressee served by AB2 wishes to have the text of  
this message verified.**

**AB2 transmits:**

Able William Mike...This is Two...Verify message...  
Time one...seven...zero...zero...Over.

**AWM transmits:**

Two...Roger...Out.

**AWM wishes to correct message, transmits:**

Xray Yoke Zebra...Message Time one...seven...zero...  
zero...Correction...Word after STORK...two...two...  
five nine...I say again...two...two...five...nine...Ac-  
knowledge...Over.

**EACH SUBORDINATE STATION sends in turn:**

**Later, to indicate receipt by addressee EACH STATION  
sends in turn, "This is ..... Your ..... Wilco... Out."**

**26. Communication among small stations.**—The following  
examples refer to communication among small stations where messages  
are seldom written down. The call signs assumed are as follows:

**EAGLE**—Controlling station.

**EAGLE 1 to EAGLE 5 inclusive**—subordinate stations.

**"Trumpet"**—net call sign.

a. EAGLE with message for whole net *transmits*:

Trumpet...This is EAGLE...Now past starting point...follow me...Over.

STATIONS reply in turn:

This is One...Wilco...Out.

This is Two...Wilco...Out.

This is Three...Say again...Over.

This is Four...Wilco...Out.

This is Five...Wilco...Out.

EAGLE *transmits*:

Three...I say again...Now past starting point...follow me...Over.

EAGLE 3 *transmits*:

This is Three...Wilco...Out.

b. EAGLE wishing to pass a procedure message for which an operating signal is applicable, *calls whole group*:

Trumpet...This is EAGLE...Change to frequency.

Crayon\*...Over.

EACH *station transmits in turn*:

Wilco—Out.

## SECTION II

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\*Crayon is assumed to be a prearranged frequency code word. For vocabulary of tested words suitable for such use see appendix VIII.

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**27. General.**—The safety of air navigation depends very much on weather conditions. Poor visibility and low ceilings are the pilot's greatest hazards. Before departing for a particular destination it is essential that the pilot know existing weather conditions en route and at his destination.

**28. Schedule of observations.**—The Civil Aeronautics Administration and the United States Weather Bureau operate and maintain weather reporting stations throughout the United States. These stations are linked by teletype circuits. All stations make a weather observation and transmit it on the teletype circuit 30 minutes after each hour throughout the day and night.

**29. Special weather reports.**—In addition to hourly reports, the station reports important changes in weather by means of a special weather report which is transmitted as soon as possible on the teletype circuit. The actual changes and limitations are beyond the scope of this manual. A special weather report is mentioned to acquaint the student with the fact that a change of some sort has taken place. By watching the reports from a particular station, the changes will be noted by either addition or omission of information in the previous report.

**30. Requirements of radio operator.**—An Army Air Forces radio operator is required to know enough about weather symbols and regulations to copy intelligently weather information as broadcast by radio range stations, Army airways stations, control towers, or any other source. In addition, he must be able to take weather reports off a teletype circuit and broadcast them at a rate of 120 words per minute plus or minus 5 percent. The speed will not be below the minimum of 114 words per minute, nor will it exceed a maximum of 126 words per minute.

**31. Composition of weather report.**—Paragraphs 32 to 53, inclusive, describe each item of a weather report in the order in which it appears in the report.

**32. Station designator.**—Combinations of two or three letters are used as station designators. The designator indicates that the weather report following it originated at that station.

**33. Classification symbol.**—All weather observations made at controlled airports will be classified according to the following limits:

a. "C"—pronounced "Contact." Weather reports containing this symbol are often referred to as "Class C weather reports" or "Class C weather." For contact weather the ceiling must be 1,000 feet or more, and the visibility must be 3 miles or more.

b. "N"—pronounced "Instrument." Weather reports containing this symbol are often referred to as "Class N weather reports" or "Class N weather." Weather conditions indicated by this symbol are below that for class C minimums but not below 500 feet ceiling and/or 1 mile visibility.

c. "X"—pronounced "Closed." Weather reports containing this symbol are often referred to as "Class X weather reports" or "Class

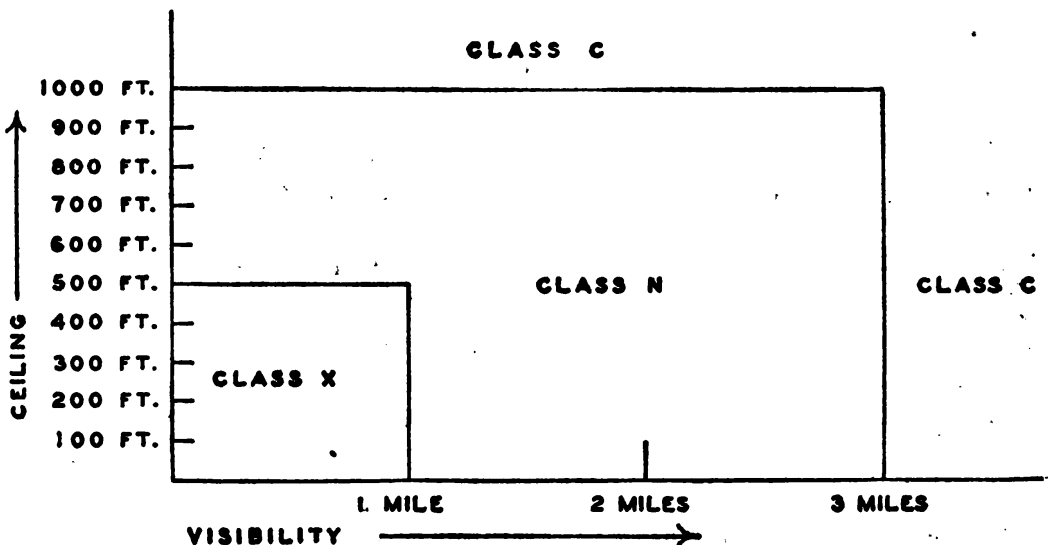


FIGURE 1.—Classification chart.

X weather." Weather conditions indicated by this symbol are below 500 feet ceiling and/or 1 mile visibility

**34. Explanation of classification chart (fig. 1).**—If either the ceiling or the visibility falls below the minimum for one of the classes, the weather report will be given the lowest classification. For example, ceiling 5,000 feet, visibility 2 miles, will be classed as instrument (N).

**35. Reasons for classification.**—Pilots on the ground or in flight, and airline companies, will depend upon and be guided by the classification of weather conditions and will make flight plans and dispatch airplanes accordingly, or may need to change or alter plans already made if the classification in airway weather sequences changes. It is the responsibility of personnel giving out weather reports orally to pilots and others to make certain that the classification of the report or reports is distinctly and clearly given and that there is no misunder-



standing on the part of the inquirer which may lead to later confusion or difficulty. During contact weather all persons may take off or land without any special equipment or qualifications, providing of course that they abide by the Civil Air Regulations. During instrument weather, it is necessary that the pilot be rated as an instrument pilot and that the ship is equipped with the necessary instruments, including two-way radio, to make a flight safely under instrument weather conditions. Class X weather indicates a closed airport. This does not mean that the airport is closed to all air traffic. Government and scheduled airline aircraft may continue to land and take off. Landings and take-offs are suspended to all other aircraft except that the control tower operator may authorize a departure provided that the ceiling is not less than 300 feet and the visibility is not less than  $\frac{1}{2}$  mile, and also provided that such airport is equipped with a radio directional aid to air navigation.

**36. Ceiling.**—This item follows the classification symbol and is the first item in the weather report proper. The ceiling as pertains to weather is the height in feet above the station reporting of the base of the lowest layer of broken or overcast clouds. Scattered clouds do not constitute a ceiling. If more than one layer of clouds is observed and reported, the base of the lower clouds is the ceiling. The ceiling is indicated to the nearest 100 feet up to 5,000 feet, and above that to the nearest 500 feet up 9,750 feet above the station. On a teletype weather report the height is indicated in hundreds of feet.

**37. Sky symbols.**—There are four basic sky symbols, often called cloud symbols. These symbols with corresponding pronunciations and limitations are as follows:

- “Clear”—Sky either clear of clouds or partly covered by clouds. The maximum amount of sky that can be covered by clouds is less than one tenth.
- ⊙ “Scattered clouds”—From one-tenth to five-tenths, inclusive, of sky covered by clouds.
- ⊙ “Broken clouds”—More than five-tenths but not more than nine-tenths of sky covered by clouds.
- ⊕ “Overcast”—More than nine-tenths of sky covered by clouds.

Example:

40⊕12 ⊙ “Ceiling 4,000 feet, overcast, lower scattered clouds at 1,200 feet.”

**38. Ceiling unlimited.—a.** The ceiling will be unlimited when—

- (1) The sky is clear.
- (2) There are scattered clouds only.
- (3) The base of the overcast or broken clouds is more than 9,750 feet above the point of observation.
- (4) There is a combination of conditions (2) and (3) above.
- (5) When the ceiling is unlimited, the figures indicating the height of the ceiling are omitted from the report. For broadcasting or other announcements of weather reports, if the ceiling is unlimited it is not mentioned.

**b. Examples:**

NK C O      "Newark, contact, clear." etc.  
 LS N 7⊕      "St. Louis, instrument, ceiling seven hundred, overcast." etc.  
 CC C 25⊕      "Cincinnati, contact, scattered clouds at two thousand five hundred."

**39. Modifying signs for ceiling.—a.** When the number itself appears indicating the height of ceiling, it indicates that the ceiling has actually been measured. Example:

23⊕      "Ceiling 2,300 feet (measured)."

**b.** When the letter "E" precedes the figure indicating height of ceiling, it means that the ceiling has been estimated by the weather observer. Example:

E65 ⊕      "Ceiling estimated six thousand five hundred, broken clouds."

**c.** When the letter "V" follows the ceiling value, it indicates that the height of the ceiling is variable. The modifying symbol "V" is used only when the ceiling is 2,000 feet or less. When the ceiling is more than 2,000 feet, variations are not reported. Example:

E5 V⊕      "Ceiling estimated five hundred, variable, overcast."

**d.** When the plus sign precedes the height of ceiling, it indicates that the ceiling is more than the figure given. Often a ceiling balloon is blown out of sight before it enters the clouds. The height of the balloon when last observed will be reported. Example:

+18⊕      "Ceiling more than one thousand eight hundred, overcast."

**40. Modifying signs for sky symbols.**—*a.* The slant (/) following a cloud symbol indicates high clouds, that is, those more than 9,750 feet above the point of observation.

*b.* The plus sign preceding a cloud symbol indicates dark clouds.

*c.* The minus sign preceding a cloud symbol indicates thin clouds.

*d.* Examples:

⊙/      “High broken clouds.”  
 8+⊕    “Ceiling eight hundred, dark overcast.”  
 50−⊙    “Thin scattered clouds at five thousand.”  
 −⊕/      “High thin overcast.”

**41. Reporting more than one layer of clouds.**—When two layers of clouds are observed they will be reported and broadcast as follows:

25⊕/⊙    “Ceiling two thousand five hundred, high overcast, lower broken clouds.”

*a.* The higher layer of clouds is more than 9,750 feet above the point of observation and the lower layer is below this level. The base of the lower level is indicated as the ceiling.

⊙/15⊙    “High scattered, lower scattered clouds at one thousand five hundred.”

*b.* The higher layer is above 9,750 feet and the lower layer is reported in hundreds of feet. In this case there is no ceiling. It is unlimited and because of this it is not mentioned during broadcasts or announcements.

40⊕⊕    “Ceiling four thousand, broken, lower broken clouds.”

*c.* The higher layer of clouds is below 9,750 feet and the lower layer is indicated as the ceiling.

*d.* Several combinations of sky symbols will be found in appendix IV.

**42. Visibility.**—“Visibility” as defined by the Weather Bureau is the mean greatest distance toward the horizon that prominent objects such as mountains, buildings, towers, etc., can be seen and identified by the normal eye unaided by special optical devices, such as binoculars, telescopes, glare-eliminating goggles, etc., and which distance must prevail over a range of half or more of the horizon.

**43. Reporting visibility.**—*a.* Visibility is the next item in a weather report immediately following the sky conditions and will be reported as follows:

0	Zero.	1½	One and one half.
⅙	One sixteenth.	1¾	One and three quarters.
⅛	One eighth.	2	Two.
⅓	Three sixteenths.	2¼	Two and one quarter.
¼	One fourth.	2½	Two and one half.
⅕	Five sixteenths.	3	Three.
⅜	Three eighths.	4	Four.
½	One half.	5	Five.
⅝	Five eighths.	6	Six.
¾	Three quarters.	7	Seven.
1	One.	8	Eight.
1¼	One and one quarter.	9	Nine.

*b.* If the visibility exceeds 9½ miles but is less than 10 miles it will be reported as 9 miles. If the visibility falls halfway between two of the above values, the lower will be used. Visibility of 10 miles or more is not reported.

*c.* Examples:

50⊕6	"Ceiling five thousand, overcast, visibility six."
E25⊕11/2V	"Ceiling estimated two thousand five hundred, broken clouds, visibility one and one half, variable."
⊕/9	"High overcast, visibility nine."
+17⊕	"Ceiling more than one thousand seven hundred, broken clouds."

In the last report the visibility is more than 10 miles because it is omitted in the report.

**44. Weather element.**—The "weather element" as defined by the Weather Bureau consists of those phenomena occurring in connection with active or imminent precipitation or meteorological disturbances of more or less localized extent and effect. This element includes the occurrence of all rain, snow, sleet, hail, freezing rain, etc., and all thunderstorms, squalls, tornadoes, etc. The weather element immediately follows the visibility in a weather report. It is indicated by various symbols included in appendix I.

**45. Obstruction to vision.**—*a.* Weather in many cases is an obstruction to vision. In addition there are conditions such as dust, smoke, haze, or any other visibility limiting factor which cannot be



classified as weather. The weather element and obstruction to vision are grouped together in a weather report.

b. Examples:

35⊕/—⊕6H	"Ceiling three thousand five hundred, high overcast, lower thin broken clouds, visibility six, hazy."
60⊕4F—	"Scattered clouds at six thousand, visibility four, light fog."
E20⊕11/2VR—F—	"Ceiling estimated two thousand, broken clouds, visibility one and one half, variable, light rain, light fog."
00L—FF	"Ceiling zero, visibility zero, light drizzle, dense fog."

**46. Sequence of weather and obstruction to vision elements.—**

The predominating weather element is indicated as the first item followed by other weather elements and obstructions to vision. Example:

T + R F — ; R — F — ; F — K — ; A + F — K — ; etc.

**47. Barometric pressure.—a.** Barometric pressure at any level is a measure of the weight of the vertical column of air of unit cross section above that level. For purposes of uniformity and comparison all pressures are reduced to sea level. Accurate data concerning barometric pressure are of high importance to the forecaster in preparation of his weather maps and forecasts. Pressure is reported in millibars and tenths of millibars but is not broadcast unless specifically requested.

*b. Sea level pressure.*—This is the sum of the station pressure and the pressure of an imaginary column of air between the station and sea level. Tables for the latter have been worked out for various stations.

*c. Station pressure.*—This is the actual barometric pressure at the station.

*d. Method of reporting.*—The barometric pressure is indicated by a group of three figures: the first two figures represent the tens and units of millibars, and the last the tenths of a millibar involved. Thus, a pressure of 987.2 millibars would be transmitted as "872," 1001.5 as "015," 1000.00 as "000," etc. The values for barometric pressure are reported immediately preceding the value for temperature.

**48. Temperature.**—The temperature of the air is of interest and importance in flying operations from the viewpoint of determining the mixture ratios for operations of aircraft engines in taking off and landing, being prepared for slow or fast landings according to whether

air immediately over the airport is unusually heated or unusually cold, etc. Also it is extremely important in airway and other forecasting work. Accordingly it is essential that it be reported properly.

**49. Dew point.**—*a.* The dew point is that temperature to which a given mixed volume of air and vapor must be reduced before saturation occurs. After further reduction of the temperature there results condensation of some of the moisture in the form of dew, fog, frost, clouds, or precipitation. Knowledge of the moisture content of the air is of extreme importance to forecasters, pilots, and others in anticipating the formation of fog, thunderstorms, cloudiness, etc. It is obvious that the dew point in a weather report will never be higher than the temperature.

*b.* Examples of reports including all elements thus far covered:

PT N E6V⊕2R—F— 987/54/53

(1) "Pittsburgh instrument, ceiling estimated six hundred, variable, overcast, visibility two, light rain, light fog, temperature five four, dew point five three," etc.

CO C —⊕/40⊕5R—F— 013/69/68

(2) "Columbus contact, high thin overcast, lower scattered clouds at four thousand, visibility five, light rain, light fog, temperature six nine, dew point six eight," etc.

LG × 01/8L—FF 999/50/50

(3) "New York closed, ceiling zero, visibility one eighth, light drizzle, dense fog, temperature five zero, dew point five zero," etc.

CV C +14⊕6⊕3F—K— 016/40/36

(4) "Cleveland contact, ceiling more than one thousand four hundred, overcast, lower scattered clouds at six hundred, visibility three, light fog, light smoke, temperature four zero, dew point three six," etc.

**50. Wind.**—*a. General.*—(1) Wind is the horizontal or nearly horizontal natural movement of air with any degree of velocity.

(2) Vertical movements of air are not considered as wind but as air currents.

*b. Direction.*—The direction of the wind is reported to 16 points of the compass. In weather reports the wind is reported by means of arrows that fly with the wind. For a chart of arrows and definitions see appendix II.

*c. Velocity.*—(1) The velocity of the wind is reported in miles per hour. The velocity may be modified by using the minus sign to indicate fresh gusts, the plus sign to indicate strong gusts. These

modifying signs follow the velocity in a report. If there is no wind blowing and a calm exists, the letter "C" will take the place of the velocity and will be announced as "Calm."

(2) Occasionally an anemometer fails and it is necessary to estimate the wind velocity. In this case the letter "E" following the velocity will indicate that the wind has been estimated. For a table of wind velocity equivalents see appendix III.

d. Examples:

→↘10	"Wind west north west one zero."
↖9E	"Wind estimated southeast nine."
↓19—	"Wind north one nine, fresh gusts."
↗25+	"Wind northeast two five, strong gusts."
C	"Wind calm."

e. Report including all data up to and including the wind:

KC C 50⊕15⊕4S—K— 000/31/28←↖24—/

"Kansas City contact, ceiling five thousand, overcast, lower scattered clouds at one thousand five hundred, visibility four, light snow, light smoke, temperature three one, dew point two eight, wind east southeast two four, fresh gusts," etc.

**51. Wind shift data.**—*a.* A wind shift is indicated whenever the wind has suddenly shifted from a southerly or easterly to a westerly or northerly quadrant, accompanied by gusty winds, rapid dew point, and/or temperature drop; in summer, usually lightning and thunder and possibly hail and intense rain; and in winter, snow squalls at frequent intervals and a rapid lowering or lifting of the ceiling. A westerly or northwesterly wind will continue to blow steadily after it has passed, the sky will usually clear rapidly, and the air will feel dryer and cooler, except in a mountainous region. For more detailed information on wind shift data and all weather reporting it is recommended that a copy of "Circular N, Instructions for Airway Meteorological Service," latest edition, be obtained from the Government Printing Office, Washington, D. C.

*b.* For example of wind shift report see paragraph 54*d.*

**52. Altimeter setting.**—*a. General.*—The altimeter setting as defined by the Weather Bureau is a pressure, in inches, used for setting a pressure-scale type sensitive altimeter in an airplane so that upon landing of the airplane at an airport the pointers of the instrument will indicate very closely the field elevation above sea level, provided the instrument is functioning properly and is free from error, and that the setting was determined by a properly equipped station near the time and place of landing, and was furnished to the pilot just prior to landing.

*b. Methods of reporting.*—Weather reports will contain an altimeter setting which may appear as 998. This actually means that the altimeter setting is 29.98 inches. The report "014" is read as "three zero one four" and indicates a pressure of 30.14 inches. Only the last three numbers of the altimeter setting appear on reports. The operator will include the missing portion. If the number is large, two will be added and if the number is small, three will be added: for example, 974 is read, "altimeter, two nine seven four"; 032 is read "altimeter three zero three two."

*c. Importance.*—(1) The importance of the altimeter setting and its proper reporting cannot be overemphasized. A pilot coming down through an overcast has no means other than the altimeter of knowing how close he is to the ground.

(2) Report including all data up to and including the altimeter setting:

LV X 2+ ⊕ 1RF—K— 976/60/60 / 19—/954

"Louisville closed, ceiling two hundred, dark overcast, visibility one, moderate rain, light fog, light smoke, temperature six zero, dew point six zero, wind southwest one nine, fresh gusts, altimeter two nine five four."

**53. Remarks.**—*a.* A space is provided at the end of a weather report for remarks concerning the report itself. It is used to amplify or modify any portion of the weather report which cannot be included in the report proper.

*b. Examples of remarks:*

+ ⊕ OBSCG MTNS	Dark clouds obscuring mountains.
⊕ ALG MTNS	Clouds along mountains.
⊕ TPG MTNS	Clouds topping mountains.
E60 ⊕	Overcast estimated at 6,000 feet. Used when appears in the body of the report and the height of the overcast must therefore be indicated in the remarks.
3 ⊕	Lower scattered clouds at 300 feet. Used when it is necessary to indicate a third layer of clouds.
+ ⊕ NW	Dark clouds northwest.
⊕ TURBT	Clouds turbulent.
2F NW	Fog bank to the northwest, visibility 2 miles.
3K NE	Smoky to the northeast, visibility 3 miles.



T APCHG SW	Thunderstorm approaching from the southwest.
RQ W	Rain squall to west.
R+ OCNLY	Rain occasionally heavy.
RE OCNLY	Sleet occasionally mixed with rain.
FK OCNLY	Smoke occasionally mixed with fog.
RANOT	Range facilities inoperative.
FANOT	Fan marker inoperative.
BRONO	Broadcast facilities inoperative.
ZONOT	Zone marker inoperative.

c. The examples in *b* above do not cover every condition but merely illustrate the method used for indicating remarks.

**54. Examples of teletype weather reports.**

LS C ⊕/20⊕ 014/30/22→\14/989

a. The above report will be read as: "St. Louis contact, high scattered, lower scattered clouds at two thousand, temperature three zero, dew point two two, wind westnorthwest one four, altimeter two nine eight nine."

ID C E12⊕⊕5SW— 999/28/24→/6/972/PIREPS +ICE CLDS

b. The above report will be read as: "Indianapolis contact, ceiling estimated one thousand two hundred, overcast, lower broken clouds, visibility five, light snow showers. Temperature two eight, dew point two four, wind westsouthwest six, altimeter two nine seven two. Pilot reports severe ice in clouds."

TH E15⊕⊕9SW— 999/30/23→\14/980

c. The above report will be read as: "Terre Haute, ceiling estimated one thousand five hundred, overcast, lower broken clouds, visibility nine, light snow showers. Temperature three zero, dew point two three, wind westnorthwest one four, altimeter two nine eight zero."

NK × E1⊕3/4R—F— 999/52/52→\16←0236E/937 CNDS VRBL

d. The above report will be read as: "Newark closed, ceiling estimated one hundred, overcast, visibility three quarters, light rain, light fog. Temperature five two, dew point five two, wind westnorthwest one six, moderate wind shift passed zero two three six, altimeter two nine three seven, conditions variable."

**55. Garbled or missing portions.**—*a.* Missing or garbled portions of weather or winds aloft reports will be announced as "Missing." Example:

LS C E60—⊕/⊕5K— 237/58/60 ↑ 16/10P

The above report will be read as: "St. Louis contact, ceiling estimated six thousand, high thin overcast, lower broken clouds, visibility five, light smoke. Temperature five eight, dew point missing, wind south one six, altimeter missing."

*b.* In copying weather reports or winds aloft reports, receiving operators will copy the letter "M" in place of any portions announced as missing. The copied report above will appear thus:

LS C E60—⊕/⊕5K— 58/M ↑ 16/M

*c.* A sample page of teletype weather reports will be found in appendix V.

### SECTION III

#### WINDS ALOFT REPORTS

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**56. General.**—Observations of upper-air wind directions and velocities are made four times each day at about 100 points in the United States. The times of observation are approximately 5 and 11 AM and PM, eastern standard time, so that all reports throughout the country are made simultaneously. These reports are transmitted over the Civil Aeronautics Administration teletype circuits in regular sequences beginning at 6:04 and 12:04 AM and PM, eastern standard time.

**57. Description of code used in reporting.**—All winds aloft reports are transmitted by means of a number code wherein the wind data are given by alternate groups of five and four digits each. The number of groups representing the surface and even 1,000-foot levels consists of five digits. The first figure indicates the level. The odd levels consist of four digits, the number indicating the level being omitted.

**58. Levels for which data are given.**—The data are given so far as they are available, for each 1,000-foot level above sea level up to

and including 12,000 feet. Wind directions are given to 36 points, that is, the direction in degrees divided by 10. Velocities are given in miles per hour.

**59. Composition of report.**—Complete reports consist of the following items:

*a. Station designator.*—This is the regular CAA two or three letter designation for the station concerned, for example, CV for Cleveland, WA for Washington, etc.

*b. Time.*—75th meridian time is used for all winds aloft reports. The 24-hour clock is used in reports. Six PM, eastern standard time, would appear as "18."

*c. Surface wind data.*—This will be the 5-digit group, the first of which will always be zero such as "02216," which would indicate a surface wind direction of 220° and a velocity of 16 miles per hour. The surface wind will not be broadcast. Surface winds change direction more often than upper winds. If a person requests surface wind information, this information will be taken from the most recent surface weather observation.

*d. Upper-air data.*—The level is indicated by a single figure or omission of the figure: for example, 2 represents 2,000 feet; the next elevation is 3,000 feet and will be indicated by no number; the next is 4,000 feet and is indicated by the figure 4. The direction is indicated by the next two figures as explained in *c* above. The velocity is indicated by the last two figures of each group. For velocities of 100 miles per hour or over, the direction numbers will be increased by 50 and the values above 100 indicated directly by the last two digits. For example, the group "87912" would indicate that at 8,000 feet the direction of the wind is 290°, 112 miles per hour.

**60. Indication of calm.**—At times there will be certain levels at which a calm exists. This calm is simply indicated by 00 for direction and 00 for velocity. North is indicated by 36 and not 00. Example: 00000 would be read as "Ten thousand, calm."

**61. No-observation report.**—*a.* In case an observation is not made or not received at the point of transmission prior to the time of filing the report, a no-observation report is filed, consisting of the following items:

(1) *Station designator.*—Same as paragraph 59*a*.

(2) *Time.*—Same as paragraph 59*b*.

(3) *Reason for no observation.*—Use one of the following words:

PICO Low clouds, none.

PIRA Raining, none.

PISO Snowing, none.

PIHE No helium, none.

PIIO Instrument trouble, none.

PIBA No balloons, none.

PIFO Foggy, none.

PIFI Not filed.

**b. Example of no-observation report:**

"CXO5 PICO" would indicate that no observation was made at Cheyenne at 5:00 AM, eastern standard time, due to low clouds. The information would be broadcast as follows: "No Cheyenne winds aloft report account of low clouds."

**62. Missing or garbled portions.**—Same as paragraph 55.

**63. Examples and phraseology used for communication or broadcasting.**—The following are winds aloft reports as they appear on the teletype circuit:

BJ11 02318 2422 22625 2728 42832 2844 62852 2967 83078 3087  
03194 8109

**a.** The above report is broken down into the following separate groups, the exact phraseology to be used for communication or broadcast purposes being inclosed in quotation marks:

BJ11 "Winds aloft report, Buffalo, one one zero zero observation."  
02318 (Surface data are not broadcast; see par. 51d.)  
2422 "One thousand, two four zero degrees, two two."  
22625 "Two thousand, two six zero degrees, two five."  
2728 "Three thousand, two seven zero degrees, two eight."  
42832 "Four thousand, two eight zero degrees, three two."  
2844 "Five thousand, two eight zero degrees, four four."  
62852 "Six thousand, two eight zero degrees, five two."  
2967 "Seven thousand, two nine zero degrees, six seven."  
83078 "Eight thousand, three zero degrees, seven eight."  
3087 "Nine thousand, three zero zero degrees, eight seven."  
03194 "Ten thousand, three one zero degrees, nine four."  
8109 "Eleven thousand, three one zero degrees, one zero nine."

CX18 01608 1714 81816 1820 02022 2120 22417 2525

**b.** The above report is broken down as follows:

CX18 "Winds aloft report, Cheyenne, one eight zero zero observation."  
01608 (Surface data, do not broadcast.)  
1714 "Seven thousand, one seven zero degrees, one four."  
81816 "Eight thousand, one eight zero degrees, one six."  
1820 "Nine thousand, one eight zero degrees, two zero."  
02022 "Ten thousand, two zero zero degrees, two two."  
2120 "Eleven thousand, two one zero degrees, two zero."  
22417 "Twelve thousand, two four zero degrees, one seven."  
2525 "One three thousand, two five zero degrees, two five."

**c.** Figures above 12,000 feet will be announced by calling the first two digits and adding the word "thousand." The last elevation in the above report is an example. Further examples:

26000 "Two six thousand."  
 17000 "One seven thousand."  
 43000 "Four three thousand."

## SECTION IV

### CONTROL TOWERS

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**64. General.**—*a.* It is the primary responsibility of the control tower operator to observe traffic conditions around the immediate vicinity of the airport and keep pilots advised of these conditions. However, the presence of a control tower in no way relieves the pilot of an airplane of the responsibility of exercising every precaution within his power to avoid hazardous situations. In some localities it is necessary to clear local tactical or training flights by agencies other than control towers.

*b.* Control towers within the United States will be designated by the name of the field at which they are located, plus the word "tower." (Control towers in oversea theaters of operations are not so designated. Communication with them is established by the use of tactical call signs.)

**65. Take-off instructions.**—*a.* Departing aircraft will contact the control tower for take-off instructions prior to taxiing away from the line or parking area and will not depart until advised to do so. Traffic control tower operators at Army Air Forces stations will include the following information in take-off instructions in the sequence given:

- (1) Wind direction and velocity.
- (2) Runway and field conditions.
- (3) Special instructions concerning local conditions.
- (4) Taxi clearance.
- (5) Take-off clearance.
- (6) Altitude of field and correct time—given only upon request of pilot.

*b.* Example of take-off instructions:

Ship: "Scott tower.. This is.. (Call sign).. Over."

Tower: "(Call sign).. This is.. Scott tower.. Over."

Ship: "Taxi clearance.. Over."

Tower: "Wind east twelve E one two. Field is soft, use east-west runway. Heavy construction in progress southeast of field. Taxi to west end of east-west runway.. Over."



Ship: "Wilco--Out."

Ship: After taxiing to take-off position. "Scott tower--This is--  
(Call sign)--Take-off clearance--Over."

Tower: "(Call sign)--Cleared for take-off--Over."

Ship: "Wilco--Out."

**66. Guarding tower frequency after take-off.**—Upon departure, airplanes will remain tuned to the tower frequency for at least 5 minutes after departure unless cleared to another frequency by the control tower.

**67. Landing instructions.**—*a.* An airplane approaching an Army Air Forces field will contact the traffic control tower when approximately 10 miles from the field. The pilot will give his position and request landing instructions. When just inside the field, the pilot will again call the tower advising him of his position. The tower will then furnish landing instructions in the following sequence:

- (1) Wind direction and velocity.
- (2) Traffic information concerning other ships in vicinity.
- (3) Field conditions including runway or area to be used in landing.
- (4) Landing sequence.
- (5) Altimeter setting—given only on specific request of pilot.

*b.* Example of landing instructions:

*c.* After landing, aircraft will remain tuned to the frequency of the tower for taxiing instructions and will remain tuned to this frequency until the aircraft has been taxied to its parking position and the engines shut off. For formations the procedure is the same except that the control tower is to be informed whether landing or take-off will be individually or in elements. Aircraft *not* equipped with radio, or having functioning receiver only, should circle the field to the left at approximately one thousand (1000) feet, attracting the attention of the control tower by alternately gunning and throttling the motor until a response is obtained.

Ship: "Chanute tower -- This is -- (Call sign) -- Over."

Tower: "(Call sign) -- This is Chanute tower -- Over."

Ship: "Ten miles north of Tuscola at two thousand feet, contact, landing at Chanute field -- Over."

Tower: "Roger -- Out."

The ship is now close to the landing field.

Ship: "Chanute tower -- This is -- (Call sign) -- Landing instructions -- Over."

Tower: "(Call sign) -- This is Chanute tower, wind southwest fifteen SW. one five. P-40 now approaching field to land. Field is soft, use the northeast -- southwest runway, you are second to land -- Over."

Ship: "Roger -- Out."

The P-40 is now on the ground and has cleared the runway.

Tower: "(Call sign) -- This is -- Chanute tower -- you are cleared to land -- Over."

Ship: "Wilco -- Out."

**68. Sighted aircraft in vicinity of field.**—*a.* Control tower operators will initiate calls to aircraft sighted approaching the field or seen taxiing out on the field that have not previously called for instructions. The type of ship and its location may be used as its call sign for this purpose. Example:

Tower: "C39 about 4 miles south of the field -- This is Chanute tower -- Over." The ship does not answer. It is assumed that his transmitter is inoperative. The tower will call again thus:

Tower: "C39 about 4 miles south of the field -- This is Chanute tower, if you are receiving me rock your wings -- Over."

*b.* If the ship is equipped with a receiver that is in operation, the pilot will acknowledge by rocking the ship's wings. The tower will then stand by. If the ship begins circling the field, the tower operator will issue landing instructions by radio, the pilot acknowledging by rocking wings. If the ship does not rock its wings upon request of the tower, the tower operator will assume that the ship has no radio facilities. If the ship begins circling the field, the tower operator will understand this as being a signal that the ship desires to land. He will then issue landing instructions by using the light gun. A table of standard light signals for control tower operation will be found in appendix VII.

## SECTION V

### CIVIL AIR REGULATIONS

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**69. General.**—An Army Air Forces operator's value to the service will be enhanced a great deal if he has a fair knowledge of such civil air regulations as pertain to air traffic rules.

**70. Contact flight.**—Contact flight is flight of aircraft in which the attitude of the aircraft and its flight path can at all times be controlled by means of visual reference to the ground or water.

**71. Instrument flight.**—Instrument flight is flight of aircraft in which visual reference is not continuously available, and the attitude of the aircraft and its flight path can be controlled in part or in whole by reference to instruments only.

**72. Airport control tower.**—An airport control tower is an establishment properly situated and equipped to allow an operator thereof adequately to control air traffic in the immediate vicinity of the airport on or adjacent to which such airport control tower is located.

**73. Civil airway.**—A civil airway is a route in the navigable air space designated by the Secretary of Commerce. It includes a stated area to either side of the center of such airway.

**74. Control zone.**—A control zone is the air space above an area within a circle with a radius of 3 miles drawn from the center of a control airport, provided, however, that if a radio directional aid station designed to direct air traffic to the control airport is more than 3 miles from the center thereof, then the control zone is extended above an area  $\frac{1}{2}$  mile on each side of a line projected from the center of such airport to such radio aid.

**75. Control zone of intersection.**—A control zone of intersection is the air space above an area within a circle with a radius of 25 miles drawn from the center of the zone of intersection.

**76. Center of control zone of intersection.**—The center of a control zone of intersection is—

- a. The radio range station located at an intersection of airways; or
- b. The center of the intersection of the on-course radio range signals projected down intersecting airways; or
- c. The center of an on-course signal projected down an airway at a point designated by the Secretary of Commerce.

**77. Flight plan.**—See paragraphs 99 and 100.

**78. Alternate airport.**—An alternate airport is an airport, other than the point of first intended landing, specified in the flight plan, and to which the flight may be directed in case of emergency.

**79. Radio fix.**—A radio fix is a geographical location on a civil airway, above which the position of an aircraft in flight can be accurately determined by means of radio only. Radio fixes may be determined by means of a cone of silence marker (Z marker), fan type marker, or intersection of range on-course signals.

**80. Check point.**—A check point is a geographical location on the surface of the land or water, above which the position of an aircraft in flight may be determined by means of visual reference.

**81. Airway traffic control area.**—An airway traffic control area is an area within the limits of designated civil airways over which a particular airway traffic control station exercises traffic control.

**82. Airway traffic control station.**—An airway traffic control station is a station operated by the Civil Aeronautics Administration for the purpose of air traffic control on civil airways within the jurisdiction of such station.

## SECTION VI

### RADIO RANGE STATIONS

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**83. General.**—Ground-to-plane and plane-to-ground communication has proved to be an absolute necessity if operation of aircraft is to be maintained with reliability and safety. Information relative to weather conditions along an airway is of vital importance to the pilot who is either flying blind, or over the top, or is about to take off for

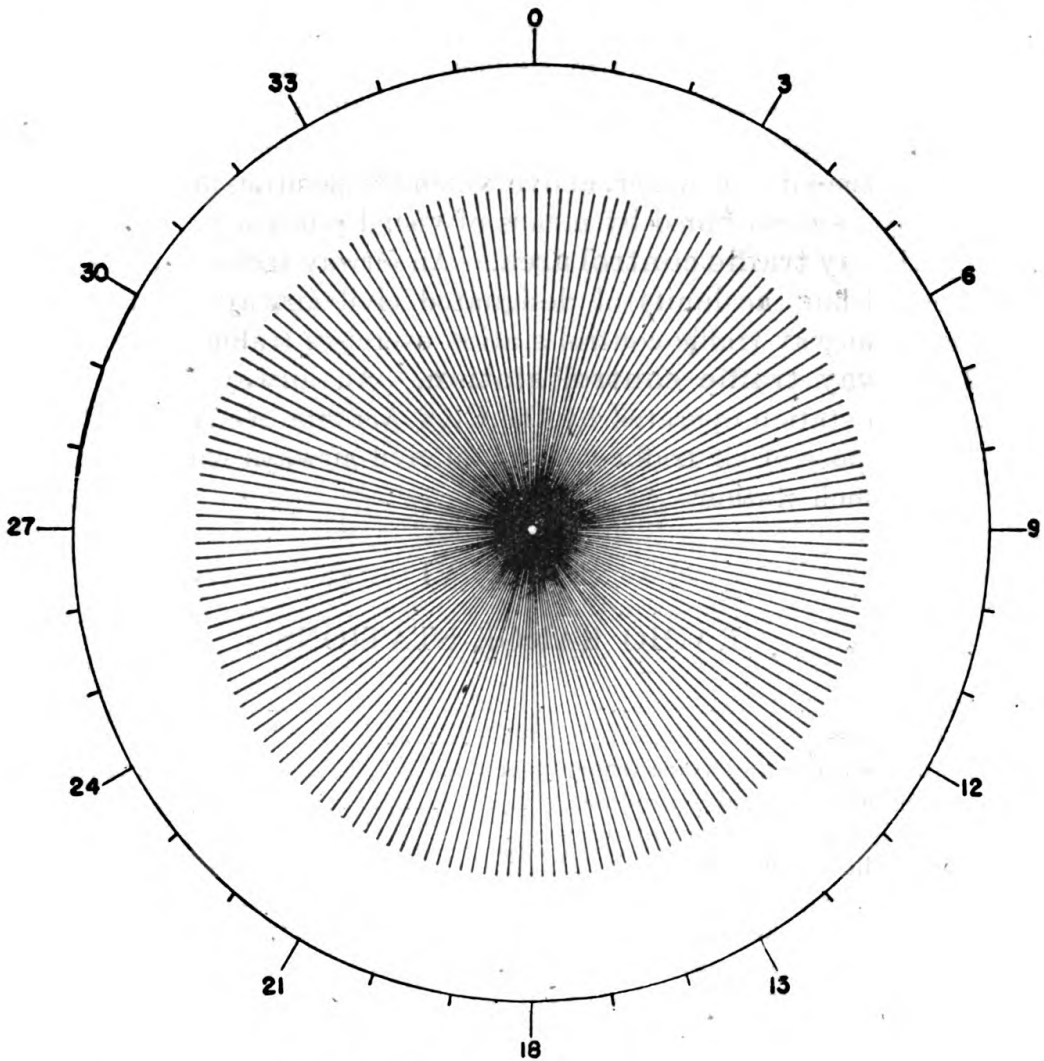


FIGURE 2.—Omnidirectional

some particular destination. To meet this requirement, the Civil Aeronautics Administration has installed and maintains radio range stations throughout the United States. These stations are located on all the airways and are the guides and markers for the aerial highways. It would be possible for a pilot to depart from Boston and fly to Seattle without ever seeing the ground, his only means of determining his position being by radio range stations.



**84. Types of ranges.**—There are several types of radio ranges. They all have the same task to perform—to produce a beam on which the pilot may depend to guide him safely to his destination. The type of range to be discussed in this section is the simultaneous radio range and voice transmitter using vertical radiators (Adcock system). Other types of ranges using loop antennas and tone modulated signals are being replaced by the more modern equipment.

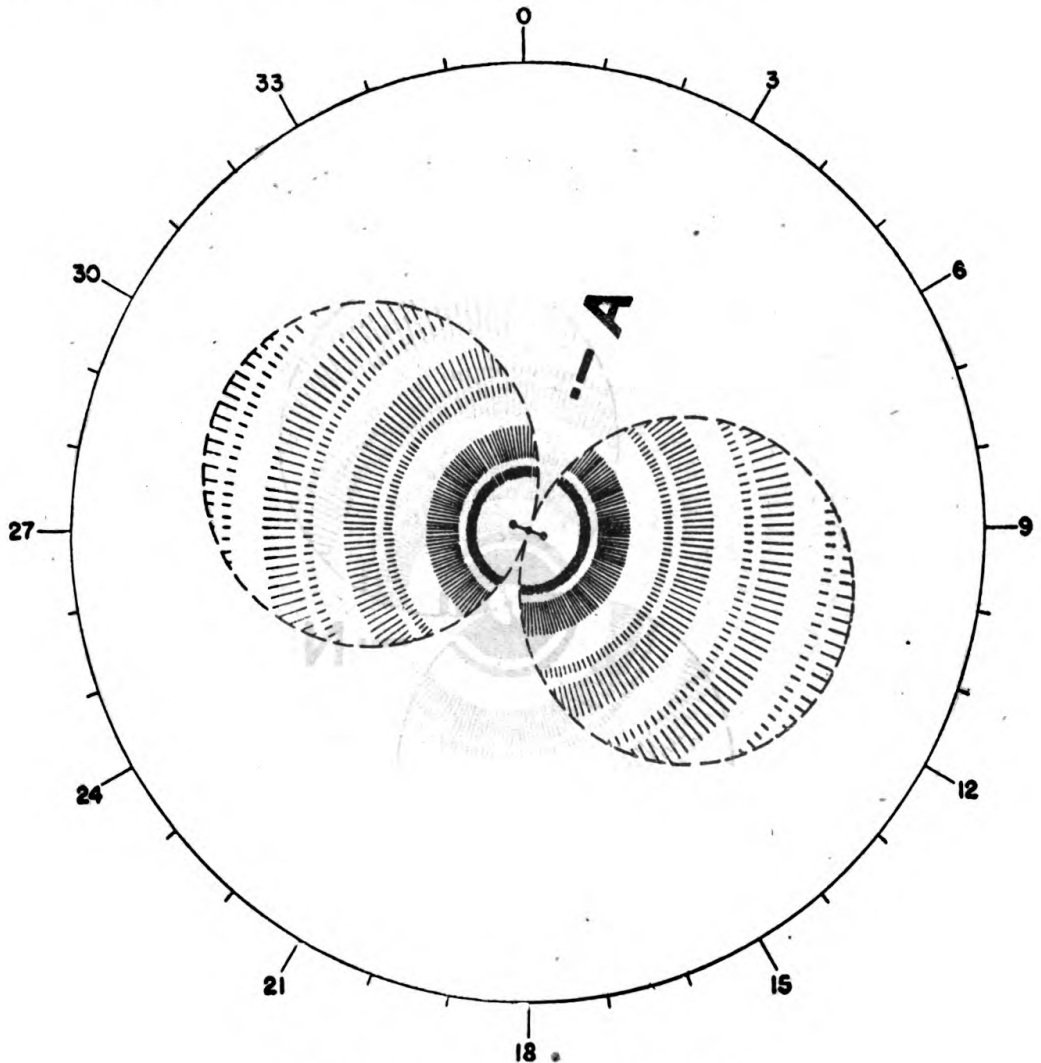
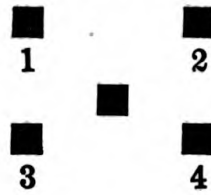


FIGURE 3.—Single loop bearing 110° and 290°.

**85. Simultaneous range and voice transmitter.**—The simultaneous range and voice transmitter consists of two complete transmitters operating on separate frequencies. The voice or carrier frequency is the assigned frequency of the station. The range or side-band frequency is 1,020 cycles higher than the assigned frequency. When both transmitters are on together, an audible heterodyne or beat frequency of 1,020 cycles is produced.

86. How an on-course signal is produced.



In the above illustration the squares represent vertical antennas or towers looking down from above. The center tower emits a continu-

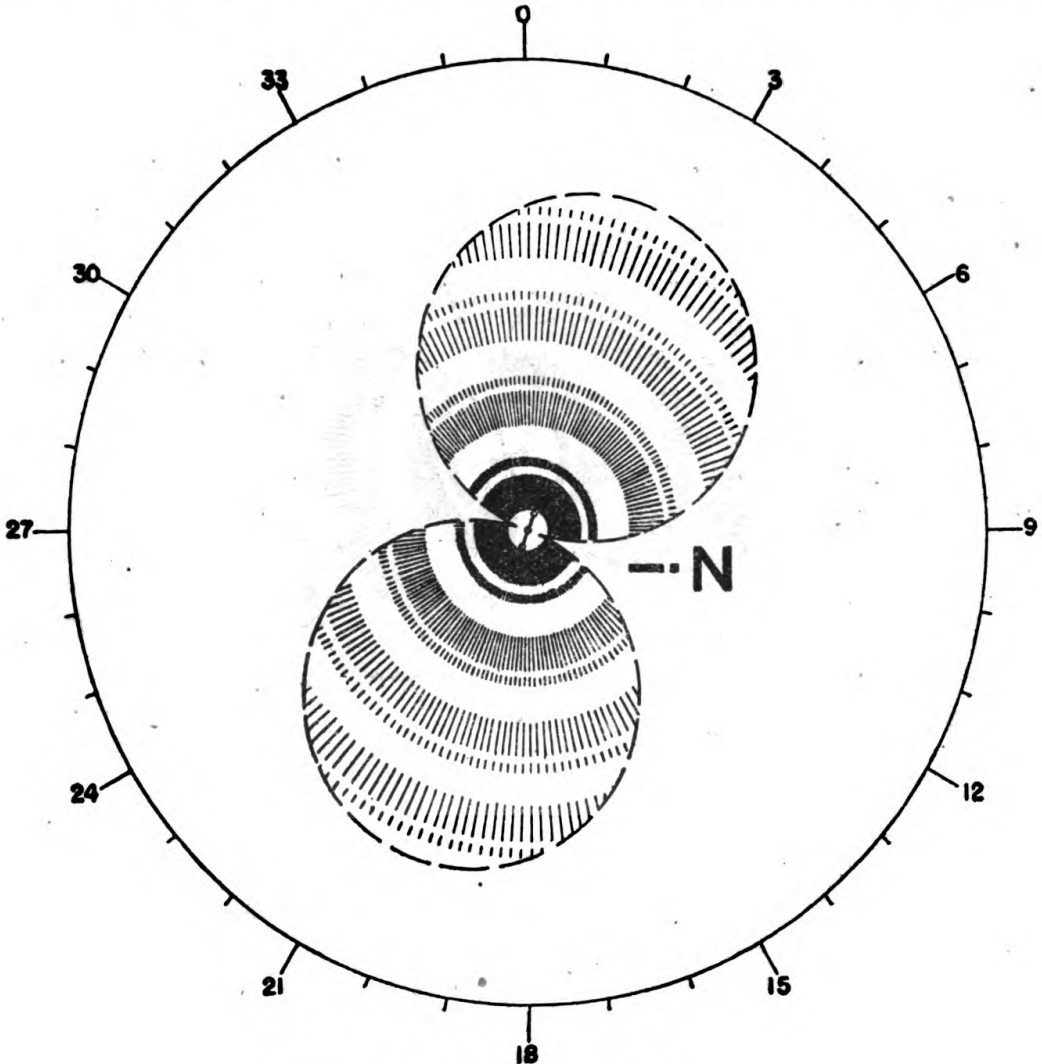


FIGURE 4.—Single loop bearing 20° and 200°.

ous uninterrupted wave on the assigned frequency (fig. 2). Towers 1 and 4 are connected together at the transmitter. Towers 2 and 3 are connected together at the transmitter. The range signal radio frequency power is fed to the opposite pair of towers. The radio frequency field pattern radiated from the two sets of towers takes the

form of two crossed figures of eight (fig. 5). A motor-driven keying device keys the letter "N" into one pair of towers (fig. 4) and the letter "A" into the other pair of towers (fig. 3). These signals are interlocked so that when received at a point along the line of equal field intensities from both pairs of towers, the N and A signals merge to form a long dash (fig. 6). This constitutes an on-course signal and

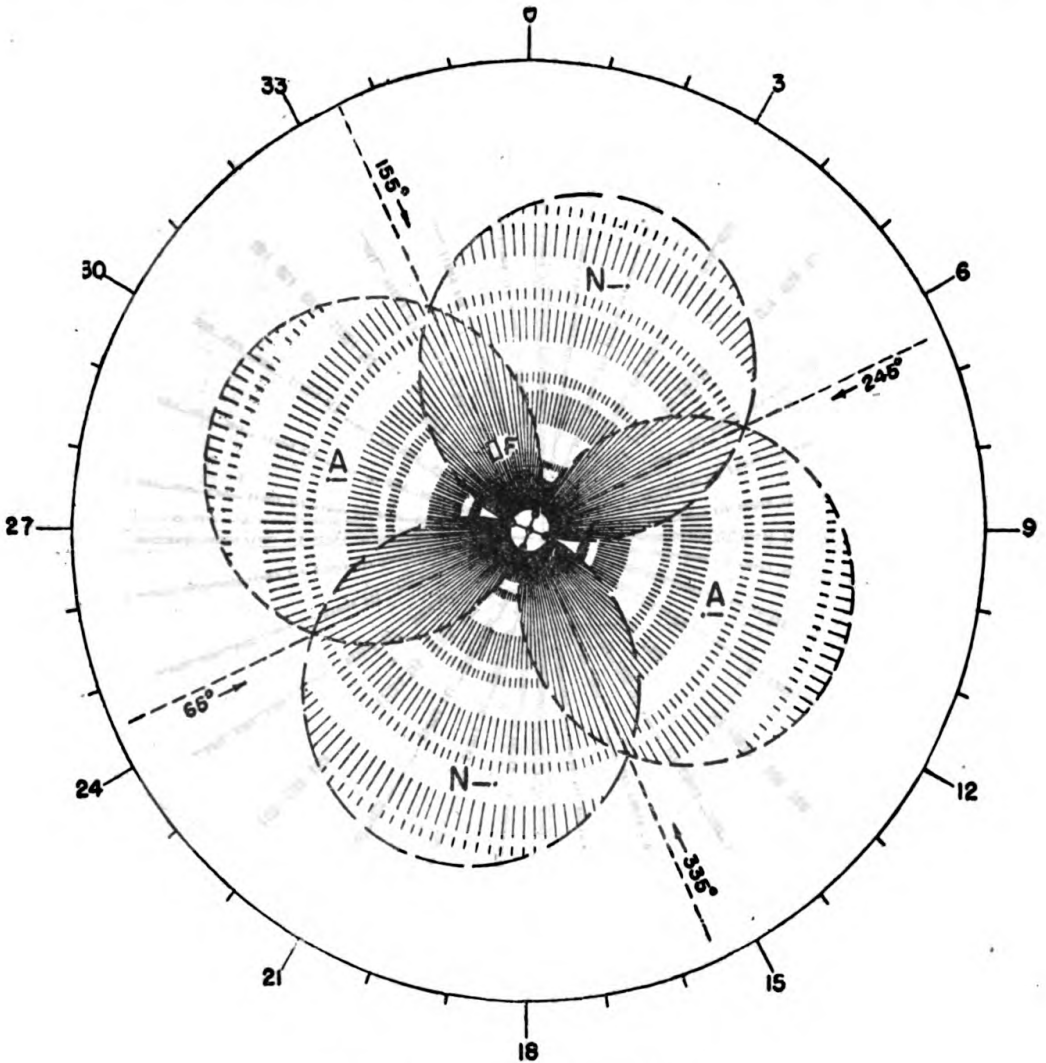


FIGURE 5.—Loops A and N combined.

is about  $3^\circ$  in width. Off course to one side or the other, either the N or the A signals predominate, since the field intensities from the two sets of towers are not equal. Thus the system gives four courses, the spaces between the courses being termed "quadrants." The interlocked signals are transmitted for approximately 29 seconds, followed by the station identifying signal which is keyed into first one pair of towers and then the other pair. The N and A signals are transmitted



such that true north line always passes through an N quadrant except when a course lies due north, in which case the N lies in the northwest and southeast quadrants.

**87. Nonscheduled or emergency broadcasts.**—Nonscheduled or emergency broadcasts on radio ranges are preceded by an attention

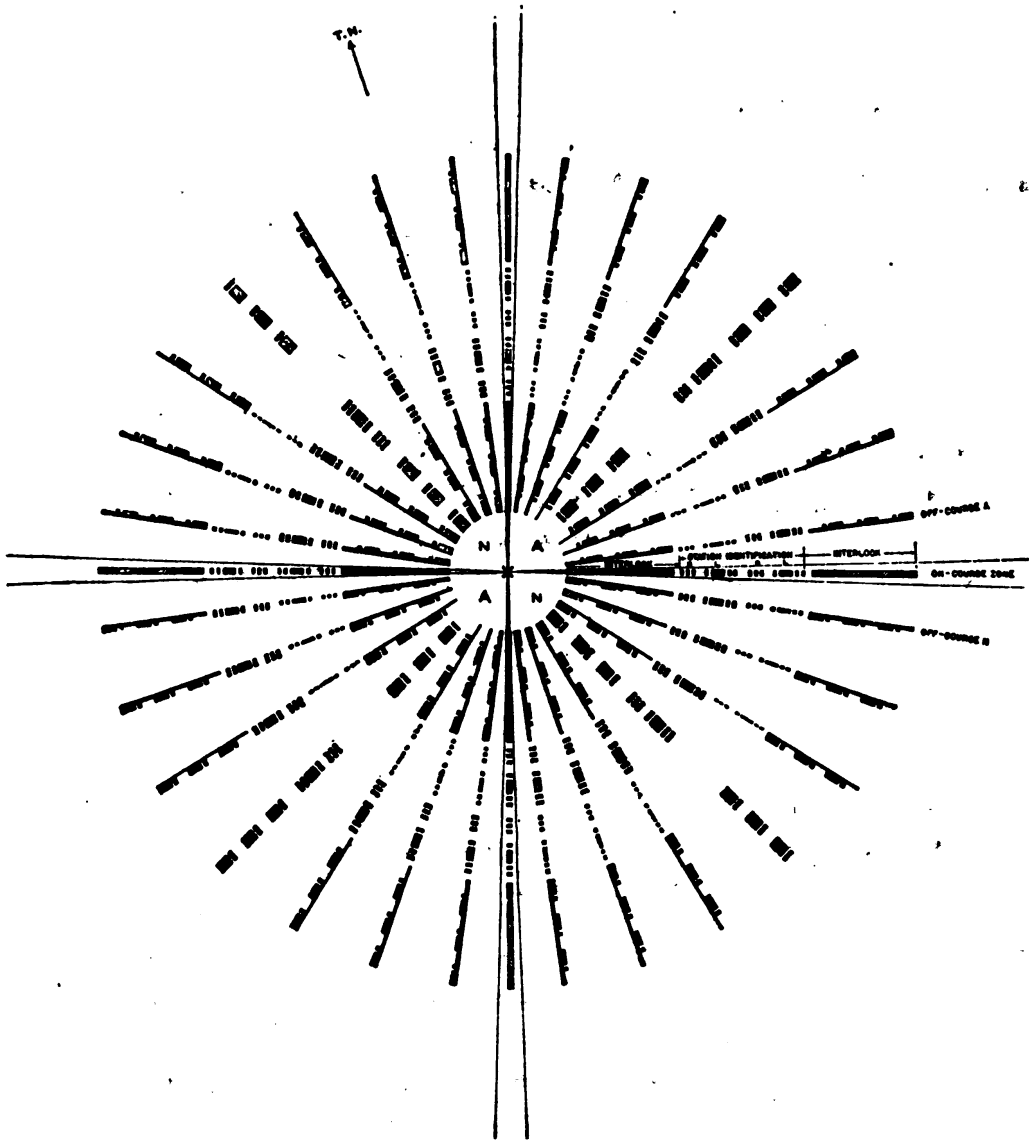


FIGURE 6.

signal consisting of a series of dots (about 10 or 12) which are transmitted for approximately 1 second. This is a warning to pilots using range filter to switch over and listen to voice.

**88. Frequency allocation.**—Radio ranges are allocated to the frequency band of 200 to 400 kilocycles.

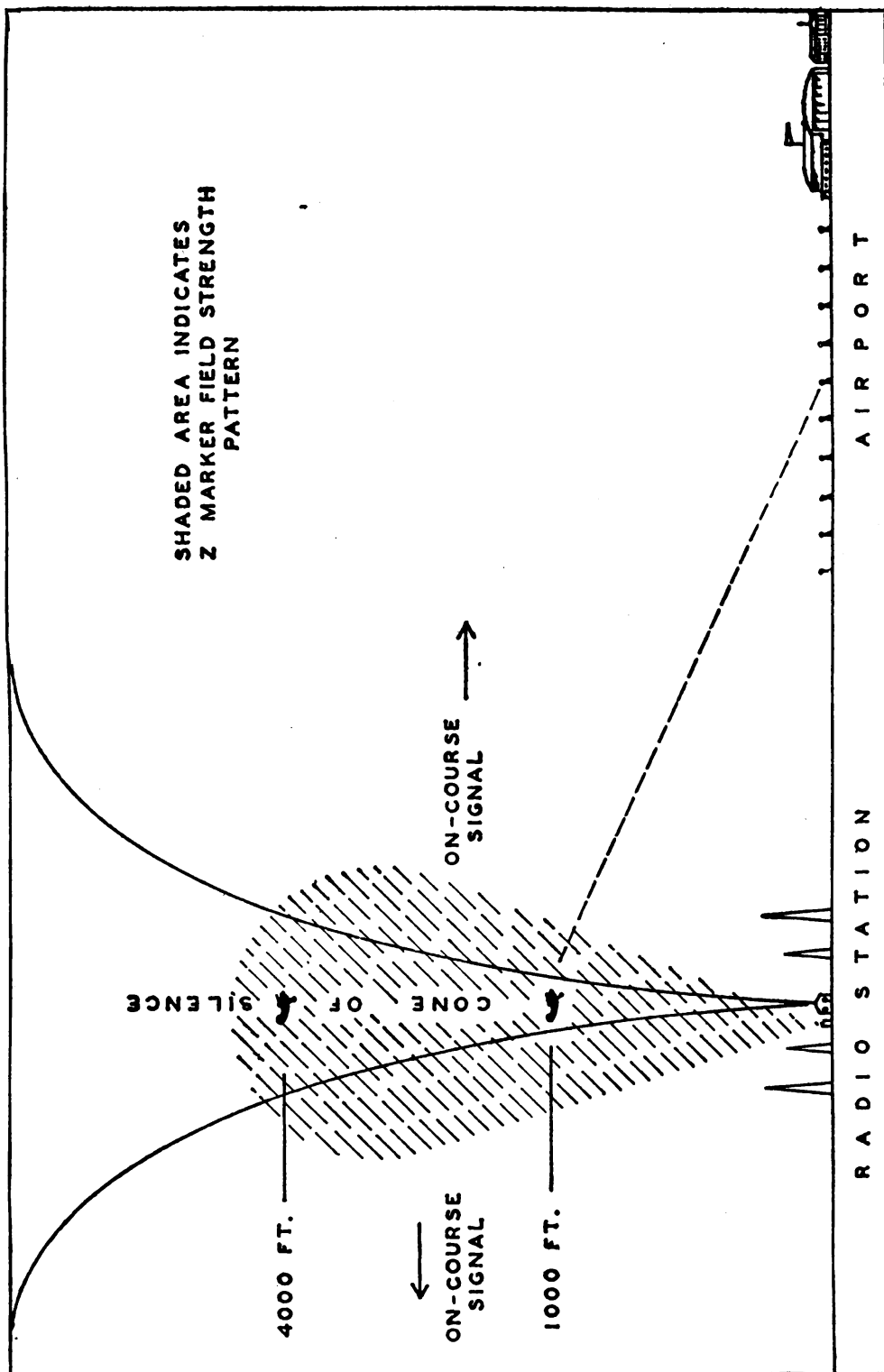


FIGURE 7.



**89. Multiple courses.**—Multiple or split courses are false on-course indications which occur in the transmission of most radio ranges located in mountainous territory. These multiple courses manifest themselves as on-course signals at points where either the

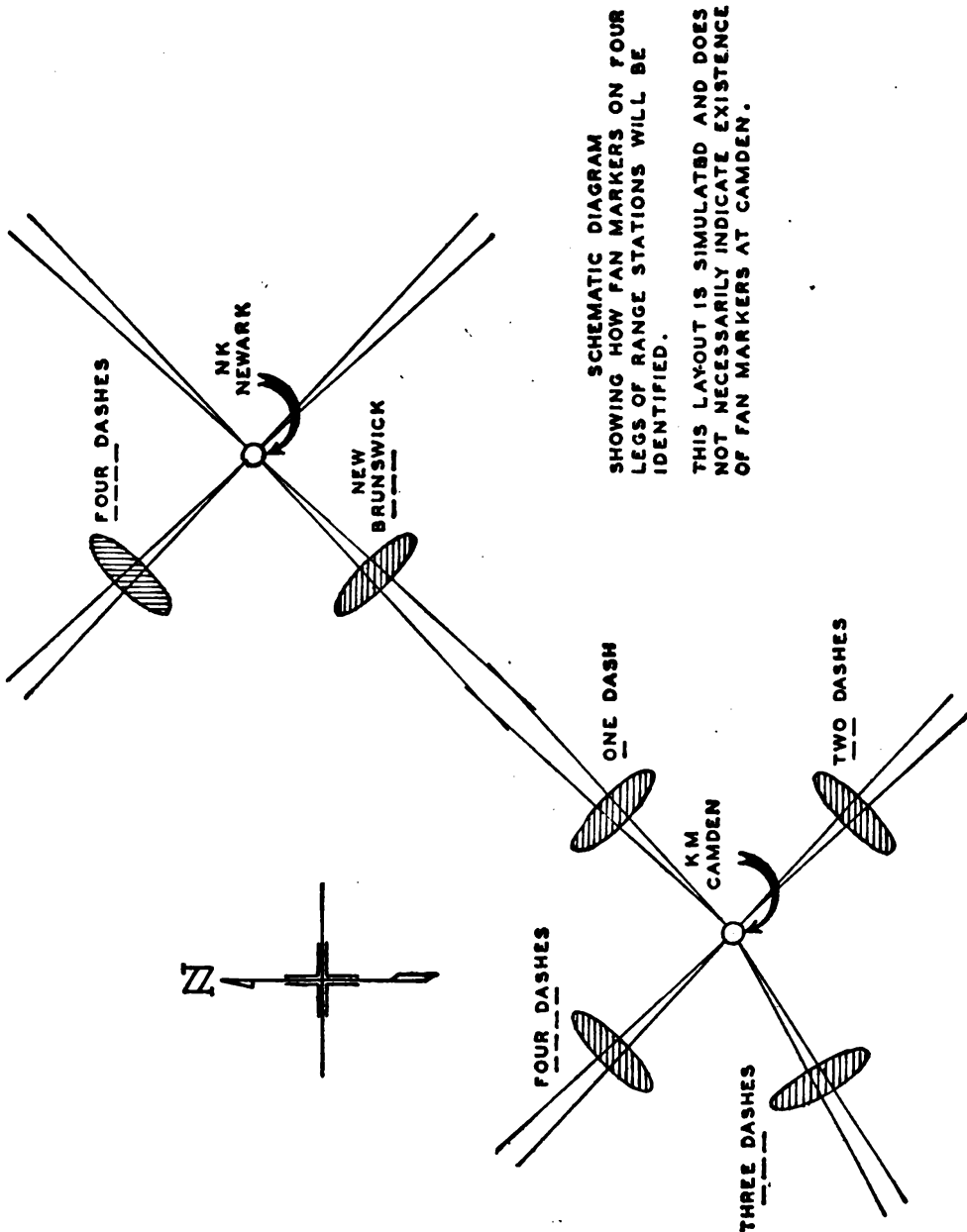


FIGURE 8.

A or the N signals should predominate and may be misconstrued by the pilot as the true on-course signal. They usually exist within plus or minus  $5^\circ$  of the true courses. At stations where multiple courses exist, airmen are warned in notices of their existence and they then use the range station accordingly.

**90. Cone of silence marker.**—A characteristic of a radio range is the cone of silence (fig. 7), a zone of zero field intensity directly above the range station caused by cancelation of the radiated field at this point. It is very useful to the pilot in determining when he has passed the radio range station. The zone of zero field intensity is proportional to the altitude, taking the form of an inverted cone. This cone of silence is so useful to pilots as an aid in orienting their position preparatory to landing that a definite and wider marker was necessary. Thus the cone of silence marker came into being. This consists of an ultrahigh frequency transmitter (75 megacycles) located near the center tower of a range station. The antenna is arranged so that the field strength pattern of the radiated signal is cone-shaped, the apex of the cone resting on the antenna. This signal is modulated with a 3,000-cycle note and is continuous. The radiated signal fills the void over the range station and definitely indicates to the pilot his exact position. To receive this signal it is of course necessary that the aircraft be equipped with a 75-megacycle receiver, also known as a marker beacon receptor.

**91. Z marker.**—See paragraph 90.

**92. Station location marker.**—See paragraph 90.

**93. Fan marker.**—A fan marker is a 75-megacycle transmitter which radiates upward a fan-shaped field strength pattern which is ordinarily placed at right angles to one of the legs of a range station. (See fig. 8.) These markers are located at definite known distances from the range station. Each marker transmits a series of dashes which identify the particular marker. The marker serves to provide the pilot with a definite fix. The identification for the various markers is such that the true north leg will be identified with one dash, or if the leg is not true north then the next leg clockwise from true north will be identified with one dash, the next leg clockwise will be identified by two dashes, etc. The transmissions are modulated with a 3,000-cycle note. Army aircraft equipped with marker beacon receptors give a visual indication by the lighting of an amber light on the instrument panel. The amber lamp will flash the number of dashes to identify the marker.

**94. False cone of silence.**—Frequent reference is made to so-called false or fake cones of silence. These false cones of silence are simply fades. Fading might occur anywhere, but it is generally confined to hilly or mountainous terrain and moderately low altitudes above the ground. Occasionally fading has been noted when flying at low altitude over high voltage transmission lines. The degree of change in signal strength is not always constant, some fades being barely perceptible. A 10 to 1 drop in signal strength is unusual except

in rugged mountainous terrain. In the Rocky Mountains abrupt changes in signal level of as much as 100 to 1 are sometimes encountered. The fades are usually of short duration. These fades have caused confusion with the true cone of silence. Ships flying toward a station equipped with a Z marker may easily disregard any fades because the true cone of silence will be indicated by reception of the Z marker signal.

**95. Radio range and flight radio operator.**—A radio operator in flight will have occasion to communicate frequently with radio range stations. The operator's transmissions will be made on the liaison transmitter. For receiving the range stations it will be necessary to use the compass receiver because the liaison receivers do not cover the frequency band to which radio range stations are assigned. Communication with range stations is at the pilot's discretion. The pilot may wish to contact the stations himself. On the other hand if the pilot desires, he will turn the compass receiver over to the radio operator and advise him to contact the range stations. The radio operator's duties will then be to transmit to the range station the ship's position report, receive weather reports at stations over which passing, and receive traffic and other information. The procedure for communicating with radio range stations is prescribed in section VII. Contacts will be businesslike and concise. The CAA personnel judge the Army Air Forces by the method in which communication contacts are handled by Army Air Forces personnel.

## SECTION VII

### PROCEDURE FOR COMMUNICATING WITH CAA RANGE STATIONS

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Instrument flight plan.....	100
Communication contacts.....	101
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**96. General.**—Pilots or radio operators will contact CAA radio range stations for the purpose of reporting their position, requesting weather and traffic information, filing flight plans, or making changes in flight plans.

**97. Position report.**—*a.* Position reports will be made to range stations in the following sequence:

- (1) Ship's call.
- (2) Name of pilot (last name only, grade is omitted).

- (3) Position.
- (4) Time over reported position. (See table, par. 9b.)
- (5) Altitude.
- (6) Flight conditions (contact, instrument, on top, between layers, etc.).

*b. Example of position report:*

Ship: "Denver radio -- This is -- (Call sign) -- Over."  
 Denver: "(Call sign) -- This is -- Denver Radio -- Send your message -- Over."  
 Ship: "(Call sign) -- Pilot Wilson, two five east of Denver, one two five zero tare, at eight thousand, on instruments. Estimating Denver at one three zero tare -- Over."  
 Denver: "(Call sign) -- Denver, pilot Wilson -- your position two five east of Denver, one two five zero tare, at eight thousand, on instruments. Estimating Denver at one three zero zero tare -- Over."  
 Ship: "That is correct -- Over."  
 Denver: "Roger -- Out."

*c. Note that the position report was repeated to the ship. This is done when requested by the pilot or when an operator is not sure of reception.*

**98. Use of tone telegraphy in contacting CAA stations.—**

*a. When unable to contact CAA stations or AAC stations by voice transmission, an attempt should be made using tone telegraphy. Radio range identification letters may be used for calling stations when reply is desired on the range frequency. When reply is desired on 4,220 kc from an AAC station, the call letters listed for these stations in the facility charts should be used. Under ordinary circumstances communication once established may then be continued by means of voice. Complete messages should not be transmitted by tone telegraph except under unusual circumstances when voice transmission is unintelligible.*

*b. Tone modulated telegraphy is stressed because continuous wave telegraphy will not be heard. Ground stations maintain a watch without the use of the beat frequency oscillator, making the use of tone telegraphy mandatory.*

**99. Contact flight plan.—***a. A flight plan is not required by civil air regulations for contact flight at any altitude outside of the boundaries of civil airways, though one may be submitted if desired. Likewise, a flight plan is not required for contact flight on or across civil airways at altitudes of 3,500 feet or less above the ground or water. However, within the limits of a civil airway, a contact flight*

made above 3,500 feet above the ground or water (not above sea level) requires the observance of instrument flight rules in the following respects:

(1) An approved flight plan before take-off from within or before entering an airway traffic control area.

(2) Maintenance of flight altitudes.

(3) Maintenance of communication contacts, therefore requiring that aircraft be equipped with two-way radio.

b. Position reports may be made, even though a flight plan has not been filed. The CAA radio operator will ask if a flight plan has been filed. If one has been filed, the CAA operator will forward the ship's progress report. If a flight plan has not been filed, the CAA operator will record the communication contact and take no further action.

**100. Instrument flight plan.**—*a.* A flight plan is not required by civil air regulations for instrument flight made entirely off airways and not entering control zones of intersection. Instrument flight made partially off airways does not require the filing of flight plan with the Civil Aeronautics Administration, provided all portions of the flight made within the airways and within control zones of intersection are made under contact weather conditions and under contact flight rules at or below 3,500 feet above the ground or water. However, when class N (instrument) or class X weather conditions prevail within the civil airways over that portion or portions within which flight is to be made, the following rules will govern:

(1) Prior to take-off from any point within an airway traffic control area and prior to entering such an area, an approved flight plan is required as prescribed in CAR 60.134.

(2) On civil airways not within an airway traffic control area, and where no approved flight plan has been obtained, no control zone of intersection, served by CAA radio voice communication station, will be entered without first establishing communication with such station, directly or through channels and forwarding essential information of the flight plan as described below:

<i>Sequence</i>	<i>Example</i>
Ship's call.....	(Call sign)
Type of ship.....	Army C-39
Pilot's name.....	Allee
Point of departure.....	Scott Field
Altitude.....	4,000 (give appropriate altitude)
Destination.....	Scott Field
Route.....	Via (give route)
Air speed.....	180



<i>Sequence</i>	<i>Example</i>
Transmitting frequency -----	4495
Time of departure -----	1042S
Estimated elapsed time -----	3 hours 10 minutes
Alternate airport -----	St. Louis (give appropriate airport)
Remarks -----	Circle flight

b. The flight plan (a(2) above), often referred to as a PX, will appear on a teletype circuit, thus:

(CALL SIGN) ARMY C39 ALLEE 4CD 40 CD VIA LS CA KC 50 CA  
LS 30 CD 180 4495 D 1042 S 3+10 LS CIRCLE FLIGHT

NOTE.—A contact flight plan is similar to an instrument flight plan except specific altitudes are not mentioned. In place of altitude the abbreviation CFR (contact flight rules) is used. An alternate airport is not included.

**101. Communication contacts.**—*a.* On an instrument flight, a continuous listening watch will be maintained on the appropriate radio frequency. The pilot or radio operator will contact and report as soon as possible to the appropriate communication station the time and altitude of passing each radio fix or other check point designated by the Secretary of Commerce or specified in the flight plan, together with unanticipated weather conditions being encountered and any other information pertinent to the aircraft movement. If not within an airway traffic control area, the pilot or radio operator will, prior to entering a control zone of intersection served by a CAA radio voice communication station, establish communication with such station, directly or through other communication channels, forwarding the expected time of arrival over the center of such zone, the altitude to be flown through such zone, and the course or courses proposed to be followed while within such zone.

*b.* Example of contact with control zone of intersection:

Ship: "Columbus radio -- This is -- (Call sign) -- Over."  
Columbus: "(Call sign) -- This is Columbus radio -- send your message -- Over."  
Ship: "(Call sign)—Pilot Case, over the Brighton fan marker, one four one five Roger, at three thousand, on instruments. Estimating Columbus one four two five Roger, at three thousand. After passing Columbus will continue on east leg of Columbus range to Cambridge, Over."  
Ship: "That is correct -- Over."  
Columbus: "Roger -- Out."

**102. Summary of communication duties.**—*a.* Whether a radio operator will or will not contact communication stations is at the discretion of the pilot. If the pilot assigns communication duties to the radio operator, he must be prepared for the task and must know what to do. Common sense in most cases will solve the difficulties.

*b.* Requests for weather information will be made after the ground station has the position report.

*c.* The receipt of a traffic clearance into a control zone is normally the pilot's duty. The radio operator may be called on, however, to copy verbatim the clearance to be given to the pilot. The first rule of communication must be remembered: *Never acknowledge or receipt for anything unless the message has been received and there is no doubt about its accuracy.* A traffic control clearance contains vital information. Many lives may depend on the accuracy with which this information is received.

*d.* Ability to copy accurately all weather reports cannot be over-emphasized. The information received will guide the pilot in making his flight under instrument conditions.

## SECTION VIII

### EMERGENCY PROCEDURE

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Transmitter adjustment for distress.....	107
Fraudulent signals of distress.....	108
Penalties.....	109

**103. Establishing contact.**—Normally, calls to aircraft will be restricted to two attempts to establish contact with an interval of 15 seconds between calls. If contact is not established, a third call will be made, after an additional 15-second interval, the communication then being transmitted as a blind broadcast and terminated by a request for receipt. If no receipt or acknowledgment is received, the three calls, followed by the blind broadcast, will be repeated at intervals of not less than 3 nor more than 5 minutes until the emergency communication has been transmitted three times.

**104. Scheduled contacts.**—When an aeronautical ground station does not receive an answer from an aircraft station at time of scheduled contact, it will repeat the call at 15-second intervals during time allotted to contact (1 minute). If the operator is unable to establish contact with the aircraft station, he will make use of all available

facilities, including CAA stations, to get information to pilot or to reestablish contact.

**105. Distress signals.**—Listed below are extracts from the general radio regulations pertaining to safety of aircraft:

*a.* In radiotelegraphy, the distress signal shall consist of the group . . . — — — . . . transmitted as one signal, in which the dashes must be emphasized so as to be distinguished clearly from the dots. This signal is often referred to as SOS. Actually SOS is meaningless. VTB, 3B, STMS, or any other combination would produce the same signal, but inasmuch as it has been customary to refer to the distress signal as SOS no attempt is being made to eliminate it. It should be borne in mind, however, that the signal is sent as one character. If it is to be recorded it may be written as SOS.

*b.* In radiotelephony, the distress signal shall consist of the spoken expression MAYDAY.

*c.* These distress signals shall announce that the ship, aircraft, or any other vehicle which sends the distress signal is threatened by serious and imminent danger and requests immediate assistance.

*d.* This call shall have absolute priority over other transmissions. All stations hearing it must immediately cease all transmissions capable of interfering with the distress traffic, and must listen on the frequency used for the distress call.

*e.* The distress call must be followed as soon as possible by the distress message. This message shall include the distress call followed by the name of the ship, aircraft, or other vehicle in distress, information regarding the position of the latter, the nature of the distress and the nature of the help requested, and any other further information which might facilitate this assistance.

*f.* When, in its distress message, an aircraft is unable to signal its position, it shall endeavor after the transmission of the incomplete message to send its call signal long enough so that the radio direction-finding stations may determine its position.

*g.* As a general rule, a ship or aircraft at sea shall signal its position in latitude and longitude (Greenwich) using figures, for the degrees and minutes, accompanied by one of the words North or South and one of the words East or West. A period shall separate the degrees from the minutes. In some cases, the true bearings and the distance in nautical miles from some known geographical point may be given.

*h.* As a general rule, an aircraft flying over land shall signal its position by the name of the nearest locality, its approximate distance from this point, accompanied, according to the case, by one of the words North, South, East or West, or, in some cases, words indicating intermediate directions.

i. The distress call and message shall be sent only by *order of the master or person responsible* for the ship, aircraft, or other vehicle carrying the mobile station.

j. Stations of the mobile service which receive a distress message from a mobile station which is unquestionably in their vicinity must acknowledge receipt thereof at once.

k. Stations of the mobile service which receive a distress message from a mobile station which unquestionably is not in their vicinity must wait a short period of time before acknowledging receipt thereof, in order to make it possible for stations nearer to the mobile station in distress to answer and acknowledge receipt without interference.

**106. Urgent signals.**—*a.* In radiotelephony the urgent signal will consist of three transmissions of the expression PAN; it will be transmitted before the call.

*b.* The urgent signal will indicate that the calling aircraft station has a very urgent message to transmit concerning its own safety or concerning the safety of another aircraft or ship.

*c.* In the aeronautical service, the urgent signal PAN will be used in radiotelegraphy and in radiotelephony to indicate that the aircraft transmitting it is in trouble and is forced to land, but that it is not in need of immediate help. This signal should, so far as possible, be followed by a message giving additional information.

*d.* The urgent signal will have priority over all other communications, except distress communication, and all mobile or land stations hearing it must take care not to interfere with the transmission of the message which follows the urgent signal.

*e.* The urgent signal may be transmitted only with the authorization of the master or of the person responsible for the aircraft.

**107. Transmitter adjustment for distress.**—The transmitting set in a radio station may be adjusted in such a manner as to produce a maximum of radiation, irrespective of the amount of interference which may thus be caused, when such station is sending radio communications or signals of distress and radio communications relating thereto.

**108. Fraudulent signals of distress.**—Section 325 of the Communication Act of 1934, paragraph A, states: "No person within the jurisdiction of the United States shall knowingly utter or transmit, or cause to be uttered or transmitted, any false or fraudulent signal of distress, or communication relating thereto."

**109. Penalties.**—Unlawful acts pertaining to radio communication are punishable by a fine of not more than \$10,000 or by imprisonment for a term of not more than two years, or both, as provided by section 501 of the Communication Act of 1934.

## SECTION IX

### FREQUENCIES

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**110. General.**—The frequencies given in paragraphs 111 to 118, inclusive, are important so far as the Army Air Forces radio operator is concerned. They are transmitting frequencies and should be memorized thoroughly.

**111. Civil control tower.**—278 kilocycles is assigned as the civil control tower frequency. Nearly all civil control towers operate on this frequency. The only exceptions are where a congestion of airports exists such as in the vicinity of New York City. In congested areas, other frequencies are assigned to minimize interference.

**112. Army control tower.**—Army control towers operate on several frequencies which are listed in the Army Air Forces radio facility charts. 396 kilocycles is most commonly used.

**113. Army air-ground.**—4,495 kilocycles is the assigned frequency to be used by Army aircraft. This frequency is strictly an Army Air Force frequency and is not used by other services.

**114. National airways.**—3,105 kilocycles is the assigned frequency for all itinerant and commercial aircraft. This frequency is occasionally used by Government services so far as aircraft are concerned. 6,210 kilocycles is a multiple of 3,105 and is authorized for use by nearly all aircraft. This frequency, however, is very seldom used.

**115. Radio range.**—200 to 400 kilocycles is the band of frequencies assigned to this service.

**116. Distress over ocean or Great Lakes.**—500 kilocycles is assigned as the international distress frequency over the ocean or Great Lakes. In addition to distress calls, this frequency may be used between ships or aircraft to establish a schedule on other frequencies. All transmissions will be kept to a minimum in this respect.

**117. Direction finders.**—375 kilocycles is assigned as the direction finder frequency.

**118. Army airways.**—4,220 kilocycles is assigned as the Army airways frequency.



**119. Guarding frequency.**—Guarding a frequency means simply to listen continuously to a radio receiver which is tuned to the frequency being guarded. Other names for guarding a frequency might be: Standing a continuous watch; maintaining a continuous watch; standing by on a certain frequency. Listening frequencies should not be confused with transmitting frequencies. A station's frequency is the frequency on which that station will *transmit*.

## SECTION X

### FACILITY CHARTS

	Paragraph
General.....	120
Weather broadcast schedules.....	121
Number and location of copies.....	122
Identification.....	123
Inspection.....	124
Record of corrections.....	125
Correcting facility charts.....	126

**120. General.**—As a visible representation of charted airways, radio facility charts are employed to aid in safety of travel. Each chart covers a specific section of the country, comprising several States. The radio ranges in these areas have been previously plotted and in most cases checked from the air as well as from the ground. Army Air Forces radio facility charts and Army Air Forces aids to airway flying are reproduced as Handbooks of Instruction, Air Forces Technical Order No. 08-15-1 and 08-15-2, for the convenience of Army Air Forces personnel. T. O. 08-15-1 contains the radio facility charts and related data; it is revised monthly. T. O. 08-15-2 contains information on airway traffic control areas, civil airways charts, list of broadcasting stations on the entertainment band, and other information not subject to frequent revision.

**121. Weather broadcast schedules.**—The weather broadcasting schedules of range stations are placed in the charts on the pages opposite the map section to which they pertain.

**122. Number and location of copies.**—Copies of T. O. 08-15-1 and T. O. 08-15-2 will be furnished to Army Air Forces stations in numbers sufficient to provide one copy per pilot and one copy per copilot of radio equipped aircraft, and one copy per aircraft radio operator.

**123. Identification.**—Army Air Forces radio facility charts will be identified at each station to which issued by placing in the space provided on the front cover the type and call letters of the aircraft to which assigned. In case of copies provided for the use of radio operators, the unit designation will be placed in this space.

**124. Inspection.**—Commanding officers of Army Air Forces stations will cause station technical inspectors to make inspections that will insure that the charts are being corrected as changes are received. The individual making the inspection will enter on the record sheet under the column "Inspected by" the date and his initials.

**125. Record of corrections.**—A record of correction form has been included on the inside of the front cover of T. O. 08-15-1. The charts will be checked before being placed in service for changes which may have occurred after the date of printing. A record of correction will be maintained on the form and all corrections entered and initialed by the individual concerned.

**126. Correcting facility charts.**—Corrections on facility charts are made in pencil on the face of the map and on the page preceding the map, using the information contained in the "Weekly Notice to Airmen." This notice to airmen is issued by the Civil Aeronautics Administration each week. Each issue will be thoroughly scanned for any items that affect changes in radio aids, changes of schedules, changes in course alinement, changes in frequency, new installations, etc. In changing course alinement, if the change is  $5^{\circ}$  or less, the figure indicating the new alinement is sufficient to indicate the change. If the change is more than  $5^{\circ}$ , a new leg will be drawn in and, a wavy line drawn through the old one to show that it no longer exists.

## SECTION XI

### TABLE NETS

	Paragraph
General.....	127
Proficiency in nets.....	128
Operation.....	129
Profanity.....	130
Practical weather test.....	131

**127. General.**—After the lecture and classroom discussion on radiotelephone procedure, the class will be divided into groups or nets. Operators will be assigned stations. Each man will act as either the pilot, control tower operator, Army airways operator, or radio range station operator. For practice purposes, the man chosen

to act as pilot will first contact the control tower for take-off instructions; next he will contact the Army airways communication station and give position report and make schedule for some later time; and then contact the range stations giving position reports and requesting weather and traffic information at stations ahead. The procedure as outlined in this manual will be observed. A businesslike attitude in all contacts will be maintained. The operator must make sure that he knows what he is going to say before beginning; there should be no hesitation in giving reports. If for some reason continuity cannot be maintained, the station being communicated with should be asked to wait. After consolidating the information which is to be transmitted, communication should be continued. Whether a call-up will again be necessary depends upon the length of time off the air. Good judgment here will be the deciding factor.

**128. Proficiency in nets.**—All stations will maintain a continuous watch during the class period. There will be only two stations in communication with each other at one time. It is up to the other stations listening in to watch for errors in procedure, weather reports, position reports, or any other errors which another station might make. The student discovering the error will notify the net supervisor by raising his hand. The one finding the error will be asked to point out the error and give a correct version of what is to be done. Corrections by other students should not be resented; they are for the benefit of all operators listening in. Any sign of resentment will severely affect the grade in proficiency. All weather reports will be intercepted and copied by all students.

**129. Operation.**—Operation in the table nets will be assumed to be the same as though one were actually in flight. If what was transmitted is not understood, repetition should be requested over the microphone, not across the table, since actual flight is being simulated.

**130. Profanity.**—Profanity and obscene language will not be tolerated. Making obscene remarks over the air is a court-martial offense. If it cannot be done over the air, there is no reason for doing it in the table nets. Students will be graded in accordance with what is done and how it is done. (See par. 107.)

**131. Practical weather test.**—A practical weather test will be given to ascertain ability to copy weather reports. Ability to transmit and copy such reports using standard symbols should be well developed. Papers will be graded and the grade received on weather reports will be added to the grades received on table net operation and written examination.

## SECTION XII

### STATION LOG

	Paragraph
General .....	132
Models .....	133

**132. General.**—*a.* A station log is a running account of station activities to include a record of stations worked and messages handled. This includes position reports, progress reports, flight plans, changes in flight plans, weather reports, frequency, changes in frequency, and any unusual conditions encountered in flight.

*b.* Form messages such as position or weather reports can easily be copied verbatim when proper procedure and authorized abbreviations are used.

*c.* Official messages addressed to commanding officers will be copied on a message form and delivered to addressee. A notation that message has been handled will be recorded in log.

*d.* Figure 9 shows a sample log kept by ship's radio operator.

*e.* Weather reports are normally copied on a special form provided for the purpose. If none is available plain paper may be used.

*f.* A sample copy of weather report and form is shown in figure 10.

## 133. Models.—See figures 9 and 10.

AIRCRAFT RADIO OPERATOR'S LOG		
SHIP'S CALL <u>8506</u>		PILOT <u>Major A. J. Wilson</u>
FREQ <u>4495</u>		RADIO OPERATOR <u>Sgt. D. Marsh</u>
FLIGHT <u>C D to DL via OL</u>		DATE <u>Oct 7 1941</u>
ALLTIMES ZONE S	STN	REMARKS
		<i>Voice communications</i>
0944	CD	5W LS 0942C 6000 cte.
0945	LS	8W LS 0944C 6000 cte. Recd wea fav.
		ZD NS TS. Cabnd B18 5000 passed
		ZD 0930C.
1034	ZD	10NE ZD 1032A 6000 on top. Recd
		wea fav ZD NS TS OL.
1135	TS	30 NE TS 1131A 6000 cte. Recd wea
		fav OL FV DL.
1224	OL	30 W OL 1222A 6000 cte, turning SW
		to intercept 5 leg OL ring and
		continue to DL. Recd wea fav
		OL FV DL.
1300		Arrive - One at 1257C 6000 on top.
1354	DL	15N DL 1353C 2000 cte eta Hensley;
		1406C. Recd wea at DL.
1400	WYO	Sent msg to C. O. Scottfield
		regarding loss of landing place.
1405	-	Landed at Hensley Field.

FIGURE 9.—Station log.



STATION	TIME OBS.	CEILING IN FT.	SKY	VIS. MILES	WEATHER OBS. TO VIS.	TEMP.	DEW POINT	WIND	ALT. SETTING	REMARKS
ZD	0930C	E20	⊙			62	55	→ 11	993	
NS	"	48	⊙260			68	58	→ 12	986	
TS	"		⊙/300			73	57	→ 10	997	
ZD	1030C	E20	⊙			64	56	→ 10	994	
NS	"	50	⊙250			69	60	→ 14	987	
TS	"		⊙/			73	57	→ 12	998	
OL	"	60	⊙/⊙	7	RW-	73	63	→ 11	990	
OL	1130C	60	⊙/⊙	7		74	65	→ 14	991	
FV	"	E30	⊙/250			72	65	→ 11	978	Decl. RW-
DL	"	E40	⊙/⊙		RW-	76	61	→ 10	981	
OL	1130C	60	⊙/⊙	7		74	65	→ 14	991	
FV	"	E30	⊙/250			72	65	→ 11	978	Decl. RW-
DL	"	E40	⊙/⊙		RW-	76	61	→ 10	981	
DL	1330C	30	⊙	4	R-	75	63	→ 11	982	

FIGURE 10.—Weather report.

# ARMY AIR FORCES

## APPENDIX I

### SYMBOLS OF WEATHER REPORT

#### 1. Weather element symbols.

Symbol	Meaning	Symbol	Meaning
R—	Light rain.	AP—	Light small hail.
R	Moderate rain.	AP	Moderate small hail.
R+	Heavy rain.	AP+	Heavy small hail.
S—	Light snow.	SP—	Light snow pellets.
S	Moderate snow.	SP	Moderate snow pellets.
S+	Heavy snow.	SP+	Heavy snow pellets.
ZR—	Light freezing rain.	T	Thunderstorm.
ZR	Moderate freezing rain.	T+	Heavy thunderstorm.
ZR+	Heavy freezing rain.	SQ—	Mild snow squall.
L—	Light drizzle.	SQ	Moderate snow squall.
L	Moderate drizzle.	SQ+	Severe snow squall.
L+	Heavy drizzle.	RQ—	Mild rain squall.
ZL—	Light freezing drizzle.	RQ	Moderate rain squall.
ZL	Moderate freezing drizzle.	RQ+	Severe rain squall.
ZL+	Heavy freezing drizzle	SW—	Light snow showers.
E—	Light sleet.	SW	Moderate snow showers.
E	Moderate sleet.	SW+	Heavy snow showers.
E+	Heavy sleet.	RW—	Light rain showers.
A—	Light hail.	RW	Moderate rain showers.
A	Moderate hail.	RW+	Heavy rain showers.
A+	Heavy hail.		

NOTE.—The word "tornado" is always written out in full.

#### 2. Obstruction to vision symbols.

Symbol	Meaning	Symbol	Meaning
F—	Damp haze.	BS—	Light blowing snow.
F—	Light fog.	BS	Moderate blowing snow.
F	Moderate fog.	BS+	Thick blowing snow.
F+	Thick fog.	GS—	Light drifting snow.
FF	Dense fog.	GS	Moderate drifting snow.
GF—	Light ground fog.	GS+	Thick drifting snow.
GF	Moderate ground fog.	BD—	Light blowing dust.
GF+	Thick ground fog.	BD	Moderate blowing dust.
GFF	Dense ground fog.	BD+	Thick blowing dust.
H	Hazy (dry haze).	BN—	Light blowing sand.
K—	Light smoke.	BN	Moderate blowing sand.
K	Moderate smoke.	BN+	Thick blowing sand.
K+	Thick smoke.	IF—	Light ice fog.
D—	Light dust.	IF	Moderate ice fog.
D	Moderate dust.	IF+	Thick ice fog.
D+	Thick dust.	IFF	Dense ice fog.

APPENDIX II

CHART OF WIND DIRECTIONS

↓	North.
↓↘	Northnortheast.
↘	Northeast.
↙←	Eastnortheast.
←	East.
↙←	Eastsoutheast.
↙	Southeast.
↙↑	Southsoutheast.
↑	South.
↗↑	Southsouthwest.
↗	Southwest.
↗→	Westsouthwest.
→	West.
↘→	Westnorthwest.
↘	Northwest.
↘↓	Northnorthwest.

NOTE.—Arrows fly with the wind.

## APPENDIX III

## TABLE OF WIND VELOCITY EQUIVALENTS

Descriptive word	Velocity (mph)	Specifications
Calm-----	Less than 1	Smoke rises vertically.
	1 to 3-----	Direction of wind shown by smoke drift but not by wind vanes.
Light-----	4 to 7-----	Wind felt on face; leaves rustle; ordinary vane moved by wind.
Gentle-----	8 to 12-----	Leaves and small twigs in constant motion; wind extends light flag.
Moderate-----	13 to 18----	Raises dust and loose paper; small branches are moved.
Fresh-----	19 to 24----	Small trees in leaf begin to sway; crested wavelets form on inland waters.
	25 to 31----	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
Strong-----	32 to 38----	Whole trees in motion; inconvenience felt in walking against the wind.
	39 to 46----	Breaks twigs off trees, generally impedes progress.
Gale-----	47 to 54----	Slight structural damage occurs (chimney pots and slate removed).
	55 to 63----	Trees uprooted; considerable structural damage occurs.
Whole gale-----	64 to 75----	Rarely experienced; accompanied by widespread damage.
Hurricane-----	Above 75----	

NOTE.— With the exception of "calm," these terms are not to be used in reporting velocity of wind.

# APPENDIX IV

## SKY SYMBOLS

A few sky symbols found in weather reports are listed below. It is not practicable to list all the possible combinations that can be made. The study of these symbols will give the student an idea of their composition and method of reporting.

30—⊕/⊕	“Ceiling three thousand, high thin overcast, lower broken clouds.”
⊕25⊕	“Scattered, lower scattered clouds at two thousand five hundred.”
—⊕/15+⊕	“High thin broken, lower dark scattered clouds at one thousand five hundred.”
40⊕	“Scattered clouds at four thousand.”
20+⊕	“Ceiling two thousand, dark overcast.”
—⊕/20+⊕	“High thin scattered, lower dark scattered clouds at two thousand.”
23⊕/⊕	“Ceiling two thousand three hundred, high scattered, lower broken clouds.”
9⊕2⊕	“Ceiling nine hundred, overcast, lower scattered clouds at two hundred.”
15⊕+⊕	“Ceiling one thousand five hundred, overcast, lower dark broken clouds.”
22⊕⊕	“Ceiling two thousand two hundred, broken, lower broken clouds.”
⊕/25⊕	“High overcast, lower scattered clouds at two thousand five hundred.”
24—⊕/⊕	“Ceiling two thousand four hundred, high thin scattered, lower broken clouds.”
15+⊕	“Dark scattered clouds at one thousand five hundred.”
32⊕/⊕	“Ceiling three thousand two hundred, high broken lower broken clouds.”



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APPENDIX V

SAMPLE TELETYPE WEATHER REPORTS

RJ E20⊕⊕ 135/62/55→↘11/993  
LS C SPL 48⊕26⊕ 112/68/58→↗12/986  
CZ ⊕/30⊕ 142/73/57↘10/997  
KC C E40⊕20⊕8 139/66/56→10/993  
KL E20⊕⊕ 65/55→↘14  
KR E35⊕ 122/66/57→↘15/988  
BN E17⊕⊕7RW—011/69/59↘9/980  
MQ 10⊕ 74/60→10  
JO SPL ⊕/60⊕ 078/68/60→13/975/OCNL RW—  
PI E30⊕25⊕ 088/72/59→11/978  
ZD SPL 32⊕⊕6RW— 102/67/60→↘19—/983  
AF E30⊕25⊕ 125/70/53→↘11/990  
NB ⊕30⊕ 74/54↘22—/LWR ⊕V⊕  
PS C E50⊕ 119/85/61→28+/989  
SO E40⊕/⊕RW— 091/76/61↗11/981  
NA C E50⊕⊕ 091/82/57→↗22—/982  
AG C —⊕/20⊕ 122/74/66→↗13/933/⊕V⊕  
CG C SPL E70⊕18⊕8 071/68/60→↗8/973  
MH —⊕/50⊕ 196/64/48↑↗23—/011  
CA E60—⊕/⊕ 210/61/45↑↗20—/013  
HA —⊕/4H 312/50/32↑↗14/041  
PT N —⊕/11/2K— 325/51/29↑↗11/045  
RF ○8 356/43/31↑7/053

# RADIOTELEPHONE PROCEDURE

## APPENDIX VI PHRASEOLOGY FOR STATING NUMBERS

### 1. Time.

AM	PM	Statement	AM	PM	Statement
12:01		Zero zero zero one.		6:00	One eight zero zero.
12:25		Zero zero two five.		9:20	Two one two zero.
6:00		Zero six zero zero.		11:50	Two three five zero.
	12:20	One two two zero.		12:00	Zero zero zero zero.
	3:02	One five zero two.			

### 2. Ceiling.

Feet	Statement	Feet	Statement
700	Seven hundred.	2, 400	Two thousand four hundred.
1, 000	One thousand.	2, 700	Two thousand seven hundred.
1, 200	One thousand two hundred.	3, 300	Three thousand three hundred.
1, 500	One thousand five hundred.	4, 600	Four thousand six hundred.
2, 000	Two thousand.		

### 3. Altitude of field.

Feet	Statement	Feet	Statement
10	Field elevation one zero.	1, 850	Field elevation one eight five zero.
75	Field elevation seven five.	2, 749	Field elevation two seven four nine.
582	Field elevation five eight two.	6, 382	Field elevation six three eight two.
600	Field elevation six hundred.		
744	Field elevation seven four four.		

### 4. Altimeter setting.

Setting	Statement	Setting	Statement
28:00	Two eight zero zero.	29:54	Two nine five four.
28:03	Two eight zero three.	30:96	Three zero nine six.
29:09	Two nine zero nine.		

### 5. Altitude in position reports.

Feet	Statement	Feet	Statement
2, 000	Two thousand.	6, 000	Six thousand.
3, 000	Three thousand.	10, 000	Ten thousand.
4, 000	Four thousand.	11, 000	Eleven thousand.
5, 000	Five thousand.	12, 000	Twelve thousand.

APPENDIX VII

STANDARD LIGHT SIGNALS—CONTROL TOWER

1. The following light signals are prescribed for use by pilots:

a. While airplane is in flight:

Green light..... Cleared to land.

Red light..... Do not land. Stay clear of field  
and continue circling.

b. While airplane is taxiing:

Green light..... Continue taxiing.

Flashing red light..... Return to hangar line.

Red light..... Stop immediately.

c. While airplane is in take-off position:

Green light..... Clear to take off.

Flashing red light..... Return to hangar line.

Red light..... Do not take off, wait.

2. If a pilot desires to land at night, he will turn on his landing lights. The tower will acknowledge this signal by use of light signals as outlined above. A series of flashes of the landing lights will indicate that—

a. If the floodlight is on, the pilot wants it turned off.

b. If the floodlight is off, the pilot wants it turned on.

## APPENDIX VIII

### HIGHLY INTELLIGIBLE WORD LIST

The following vocabulary was developed to do away with the unsatisfactory practice of picking words at random, without regard for their intelligibility or their similarity in sound to other words, for use in temporary military codes, as telephone unit names of radio stations (see pars. 10, 11, 19, and 23), ships, planes, tanks, and infantry, as standardized operational commands, and for any similar needs that arise in the course of military communication. This carefully tested vocabulary meets the following criteria:

1. All the words are of sufficiently high intelligibility to insure the maximum articulation when spoken against the noise of engines or gunfire.
2. All the words are suitable for use in military communications, in that—
  - a.* They do not conflict with speech signals already standardized for use as alphabetic equivalents, R/T procedures, etc.
  - b.* None of them is a geographic or place name.
  - c.* None of them has undesirable connotations, such as facetiousness, negative morale value, etc.
  - d.* They are long enough to provide intelligibility without being too long for messages in which speed and economy are essential.
3. They include large numbers of names for commonly recognized classes and subclasses of objects (arranged in table II under animals, minerals, plants, etc.) which can be used to identify the inter-relationships of military units.

# ARMY AIR FORCES

TABLE I

## A RECOMMENDED VOCABULARY OF WORDS INTELLIGIBLE IN NOISE

### A (82 words)

Abandon	Agressive	Andrew	Argument
Abide	Agrippa	Anecdote	Armadillo
Abigail	Airedale	Angular	Arrival
Ablaze	Alabaster	Annoy	Arrow
Abound	Alamo	Anteater	Artichoke
Abraham	Albatross	Antelope	Asparagus
Abridge	Album	Anthracite	Asphalt
Absalom	Alcove	Anvil	Aster
Absolute	Ale	Anyhow	Athletic
Abundance	Alert	Apache	Audacity
Academy	Alfalfa	Apology	Autograph
Accordion	Alligator	Appear	Avocado
Accustom	Almanac	Appetite	Avail
Acrobat	Alone	Apple	Avalanche
Adam	Alpaca	Applejack	Avenger
Add	Already	Approval	Avowal
Admire	Aluminum	Apricot	Award
Adore	Amaze	Aquamarine	Away
Adventure	Amber	Arabian	Aztec
Advocate	Amiable	Arena	
Agate	Anaconda	Argue	

### B (63 words)

Baboon	Bassoon	Blackmail	Broadcloth
Backbone	Baylor	Blackout	Broncho
Badger	Beaver	Blanket	Brother
Bagpipe	Beehive	Bloodhound	Brown
Balcony	Behold	Bloodstone	Buccaneer
Ballyhoo	Believe	Blueberry	Buchanan
Bamboo	Belligerent	Bluebird	Bucknell
Banana	Benjamin	Bluejay	Buffalo
Barbara	Beulah	Bobolink	Bugle
Barium	Beware	Bobwhite	Bulldog
Barley	Beyond	Bollweevil	Bumblebee
Barnabas	Bible	Bookkeeper	Buoyant
Barnacle	Big Dipper	Border	Burro
Barnard	Blackberry	Boycott	Buttercup
Barricade	Blackbird	Bravery	Butterfly
Bartholomew	Blackfeet	Brazil-nut	



# RADIOTELEPHONE PROCEDURE

## C (97 words)

Cabbage	Champion	Cockatoo	Corduroy
Calcium	Chandelier	Coconut	Corinthians
Calculate	Charcoal	Codfish	Cormorant
Camel	Chariot	Colgate	Cornell
Camellia	Cherokee	Collect	Cornet
Canary	Chestnut	Columbia	Correspond
Canopy	Cheyenne	Comanche	Corridor
Carbolic	Chickasaw	Commonwealth	Cosine
Cardinal	Chimpanzee	Companion	Courageous
Cargo	Chinook	Compliment	Crab
Caribou	Chippewa	Compromise	Cradle
Carnation	Chloroform	Composer	Cranberry
Casino	Choctaw	Concentrate	Crayon
Castanet	Chowder	Conclude	Create
Casual	Chowmein	Condor	Creditor
Catapult	Chromium	Confederate	Crocodile
Caterpillar	Chronicles	Confine	Crystal
Catfish	Cinema	Conform	Cuckoo
Cauliflower	Clam	Consider	Cucumber
Cavalier	Clarinet	Constitution	Curfew
Caveman	Classify	Contemplate	Cyclone
Cecilia	Cleveland	Continue	Cypress
Celery	Clover	Contradict	
Cello	Cobalt	Coolidge	
Ceremony	Cobra	Cooperate	

## D (48 words)

Daffodil	Delilah	Dilute	Donkey
Daily	Deliver	Dinette	Doorway
Dalmatian	Demand	Director	Dormouse
Dandelion	Democrat	Diverging	Double-bass
Daniel	Destroy	Dividend	Dragon
Darling	Develop	Document	Dragonfly
Dartmouth	Devour	Dodo	Dribble
Daydream	Diagram	Dogma	Drudgery
Debate	Dial	Doll	Duke
Debonaire	Dialogue	Dollar	Duquesne
Deborah	Diamond	Dominate	Dynamite
Decoy	Digress	Domino	Dynamo

# ARMY AIR FORCES

## *E* (42 words)

Eagle	Elephant	Endure	Explain
Eardrum	Elevate	Engineer	Explore
Early	Elisha	Enjoy	Eyeball
Earmark	Elm	Enormous	Eyebrow
Earphone	Embargo	Enterprise	Eyeful
Earthworm	Embark	Episode	Eyeglass
Ebony	Embody	Equal	Eyesight
Ecclesiastes	Emerald	Escape	Ezekiel
Educate	Enable	Eskimo	Ezra
Eggplant	Enamel	Eureka	
Elbow	Endow	Exile	

## *F* (23 words)

Featherweight	Ferryboat	Flannel	Forego
Feldspar	Fillmore	Flexible	Formal
Fellowship	Final	Flounder	Formula
Felony	Firebrand	Flying Fish	Fortune
Female	Firefly	Fordham	Fox Terrier
Ferocious	Flamingo	Forefather	

## *G* (43 words)

Gabardine	Genesis	Golden	Gravity
Galatians	Genuine	Goldenrod	Gravy
Galilee	Georgetown	Goliath	Gray
Galley	Geranium	Gondolier	Great Dane
Gallows	Germ	Gorilla	Greenhorn
Galvanize	Gigantic	Governor	Grenade
Gangway	Giraffe	Gradual	Greyhound
Garter Snake	Glorify	Granite	Guarantee
Gay	Glory	Grapefruit	Guardian
Gazelle	Glowworm	Graphite	Guitar
Generate	Gold	Gravel	

# RADIOTELEPHONE PROCEDURE

## *H* (38 words)

Halibut	Haverford	Holy Cross	Hosea
Halloween	Heavy	Honeybee	Household
Handicap	Hebrews	Honeycomb	Huckleberry
Harangue	Hedgehog	Honeysuckle	Hummingbird
Harding	Heroic	Hoover	Humorous
Hardware	Hickory	Horizon	Huron
Harlequin	Highway	Horn	Hurricane
Harmonica	Hippopotamus	Hornet	Hyena
Harpsichord	Hiram	Hornpipe	
Harvard	Holly	Horsefly	

## *I* (35 words)

Iceberg	Impede	Influence	Isaac
Icecold	Imperial	Inform	Isaiah
Icecube	Implement	Interlude	Isolate
Ideal	Important	Intern	Israel
Identical	Inaugurate	Iodine	Italic
Igloo	Independent	Iris	Itemize
Ignore	Indigo	Iron	Ivory
Illuminate	Infallible	Ironie	Ivy
Immigrate	Inferno	Iroquois	

## *J* (28 words)

Jackall	Jefferson	Joab	Journey
Jackknife	Jehoshaphat	Johns Hopkins	Joy
Jackrabbit	Jeremiah	Johnson	Joyful
Jacob	Jericho	Joint	Jubilee
Jaguar	Jerome	Jonah	Juniper
Jasper	Jewelry	Jonathan	Jupiter
Jawbone	Jezebel	Joshua	Justify

## *K* (8 words)

Kangaroo	Kettledrum	Kilowatt	Kitchenette
Kayak	Keyhole	Kingfisher	Knicknack

# ARMY AIR FORCES

## *L* (32 words)

Lady	Lemon	Lily	Lobster
Lamentations	Leopard	Lime	Lonely
Landlubber	Leviticus	Limeade	Loyal
Larkspur	Liable	Limelight	Loyola
Lavender	Liberty	Limestone	Lullaby
Lawyer	Lignite	Lincoln	Luminous
Lazarus	Lightning	Linoleum	Lurid
Legislate	Lilac	Lion	Luxury

## *M* (48 words)

Macaroon	Marine	Migrate	Moonshine
Magdalene	Maritime	Milky Way	Mordecai
Magnesium	Maroon	Minnow	Morning
Magnolia	Marquette	Mockingbird	Morning-glory
Magnify	Martha	Modify	Mosquito
Magpie	Matthew	Modulate	Motivate
Mahogany	Mayflower	Mohawk	Mule
Majesty	McKinley	Mohican	Multitude
Mandolin	Melody	Molecule	Mushroom
Manganese	Mercury	Monarchy	Muskrat
Mania	Methuselah	Monroe	Myopia
Margin	Mica	Monument	Mystify

## *N* (38 words)

Naomi	Newspaper	Nitrate	Notre Dame
Natural	Nicholas	Noah	Novelty
Navaho	Nickel	Noble	Now
Navigate	Nicodemus	Noise	Nowhere
Nearby	Nightfall	Nominate	Nucleus
Nebuchadnezzar	Nightgown	Normal	Nugget
Nebular	Nighthawk	Northern	Nursemaid
Necessary	Nightingale	North Star	Nutmeg
Neptune	Nightmare	Notebook	Nylon
	Nimrod	Notify	

# RADIOTELEPHONE PROCEDURE

## *O* (41 words)

Oasis	O'clock	Orange	Outside
Oatmeal	October	Orangutang	Oven
Obadiah	Octopus	Organize	Overlay
Obedient	Olive	Orchid	Overtone
Obey	Oliver	Ordain	Overture
Object	Onion	Organ	Owl
Obscure	Onset	Orient	Oyster
Obsolete	Opal	Origin	Ozone
Occupy	Opinion	Oriole	
Occur	Opium	Outboard	
Ocean	Opulence	Outrageous	

## *P* (52 words)

Pagoda	Perform	Pomeranian	Prohibit
Pajama	Piano	Pony	Prolong
Paramount	Piccolo	Poodle	Protect
Parole	Pigeon	Porcupine	Proverbs
Parsley	Pillow	Porpoise	Proviso
Pawnee	Pine	Potassium	Pudding
Peacock	Pineapple	Potato	Pugilism
Pearl	Pistachio	Premium	Pumpkin
Peculiar	Platinum	President	Purdue
Pelican	Pliable	Presuming	Purify
Pendulum	Pluto	Primeval	Purple
Penguin	Pointer	Princeton	Pyramid
Pennyweight	Polar Bear	Principal	Python

## *Q* (8 words)

Quadruple	Quarterback	Quibble	Quinine
Quail	Queer	Quiet	Quiver



# ARMY AIR FORCES

## R (64 words)

Rabbi	Rayon	Relate	Rhubarb
Racoon	Real	Relative	Ripen
Radcliffe	Realize	Reliable	Rival
Radiate	Rebecca	Remedy	Robin
Radish	Rebuke	Repay	Robust
Radium	Recall	Repel	Romance
Railroad	Recognize	Reporter	Romantic
Rainy	Recommend	Republic	Roosevelt
Rally	Recorder	Resist	Round
Ram	Recover	Resolute	Royal
Random	Red	Resolve	Royalty
Rare	Refugee	Reuben	Ruby
Raspberry	Regalia	Reveille	Ruin
Ratio	Regard	Revelation	Ruler
Rattlesnake	Regulate	Revival	Runabout
Raven	Reindeer	Rhinoceros	Rutgers

## S (68 words)

Sailor	Seldom	Solitude	Stimulate
Salamander	Semaphore	Solomon	Stork
Salvo	Seminole	Southern Cross	Story
Samaritan	Shadrack	Spaniel	Strawberry
Samuel	Shallow	Sparrow	Sturdy
Sandpiper	Shamrock	Sparrow Hawk	Subway
Sandwich	Signify	Speculate	Sunfish
Sapphire	Silkworm	Spider	Sunflower
Sardine	Silver Fox	Spinach	Supreme
Saxophone	Singular	Spiral	Surprise
Scallop	Sirius	Squid	Survey
Schooner	Skillet	Squirrel	Survival
Scorpion	Smile	Stampede	Swallow
Sea Bass	Snail	Stanford	Swordfish
Sea Gull	Sodium	St. Bernard	Symbolic
Sea Lion	Soil	Sterilize	Symphony
Secular	Soldier	Stiletto	Synchronize

## RADIOTELEPHONE PROCEDURE

### *T* (38 words)

Tabloid	Thereby	Transact	Turkey
Tabulate	Therewith	Transform	Turmoil
Tadpole	Thoroughbred	Translate	Turnip
Tambourine	Thunderbolt	Triumphant	Turpentine
Tantalize	Thyself	Trombone	Turquoise
Tarantula	Tiger	Troubadour	Tyler
Telegram	Tomato	Trout	Typewriter
Terrify	Topaz	Trumpet	Typhoon
Theater	Torpedo	Tuba	
Theophilus	Tranquil	Tunafish	

### *U* (20 words)

Ukulele	Unholy	Unroll	Uranium
Umbrella	Unify	Uphold	Uranus
Umpire	Union	Uproar	Uriah
Unaware	Unique	Upstairs	Useful
Undermine	Unite	Uptown	Usual

### *V* (20 words)

Vagabond	Verify	Villanova	Vitamin
Value	Vermilion	Viola	Vocalize
Vampire	Vestibule	Violate	Voice
Van Buren	Victory	Violin	Volunteer
Vanderbilt	Vigilant	Viper	Vulture

### *W* (40 words)

Wagon	Warfare	White	Wolverine
Walkover	Washington	Whitefish	Woman
Wall	Watermelon	Wildcat	Wonder
Wallflower	Watersnake	Willow	Wonderful
Wallop	Wedding	Window	Wood
Walnut	Welcome	Wintergreen	Woodchuck
Walrus	Welfare	Wire	Woodpecker
Wanderlust	Whale	Without	Wool
Warbler	Whippoorwill	Wolf	Work
Wardrobe	Whirlabout	Wolfhound	Worry

# ARMY AIR FORCES

X, Y, Z (16 words)

Xylophone	Yell	Yodel	Yuletide
Yankee	Yellow	Yonder	Zechariah
Yard	Yelp	Young	Zigzag
Yearn	Yeoman	Yourself	Zodiac

TABLE II

## A LIST OF CLASS NAMES INTELLIGIBLE IN NOISE

		1. Domestic
		2. Predatory
	A. Land animals-----	3. Nonpredatory
		4. Insects
		5. Reptiles
I. ANIMAL		
	KINGDOM---	
	B. Birds-----	1. Garden
		2. Prey
		3. Marine
	C. Fish-----	1. Small Fish
		2. Sea Monsters
		3. Shell Fish
	A. Flowers	
	B. Fruits	
II. VEGETATION-----	C. Trees	
	D. Vegetables	
	A. Metals	
III. MINERALS-----	B. Rocks	
	C. Precious stones	
	A. Proper names-----	1. Male
IV. BIBLICAL NAMES--		2. Female
	B. Books of the Bible	
V. AMERICAN COLLEGES		
VI. PRESIDENTS OF THE UNITED STATES		
VII. AMERICAN INDIAN TRIBES		
VIII. MUSICAL INSTRUMENTS		
IX. COLORS		
X. STARS AND CONSTELLATIONS		
XI. TEXTILES		

I—ANIMAL KINGDOM

A. Land animals.

1. *Domestic*: (19 words)

Airedale	Dalmatian	Greyhound	Poodle
Bloodhound	Dog	Mule	Spanish
Broncho	Donkey	Pointer	St. Bernard
Bulldog	Fox Terrier	Pomeranian	Wolfhound
Burro	Great Dane	Pony	

2. *Predatory*: (12 words)

Dragon	Jaguar	Orangutang	Tiger
Gorilla	Leopard	Polar Bear	Wildcat
Hyena	Lion	Silver Fox	Wolf

3. *Nonpredatory*: (26 words)

Anteater	Camel	Hippopotamus	Reindeer
Antelope	Caribou		Rhinoceros
Armadillo	Chimpanzee	Jack Rabbit	Sea Lion
Baboon	Elephant	Kangaroo	Squirrel
Badger	Gazelle	Muskrat	Walrus
Beaver	Hedgehog	Porcupine	Woodchuck
Buffalo		Raccoon	Zebra

4. *Insects*: (14 words)

Boll Weevil	Earthworm	Honeybee	Silkworm
Butterfly	Firefly	Horsefly	Spider
Caterpillar	Gadfly	Mosquito	Tarantula
Dragonfly	Glowworm		

5. *Reptiles*: (12 words)

Alligator	Crocodile	Rattlesnake	Tadpole
Anaconda	Garter Snake	Salamander	Viper
Cobra	Python	Scorpion	Watersnake

B. Birds.

1. *Garden birds*: (28 words)

Blackbird	Cockatoo	Nightingale	Sandpiper
Bluebird	Cuckoo	Oriole	Sparrow
Bluejay	Hummingbird	Peacock	Stork
Bobolink		Pigeon	Swallow
Bobwhite	Kingfisher	Quail	Turkey
Canary	Magpie	Raven	Warbler
Cardinal	Mockingbird	Robin	Whippoorwill
			Woodpecker

## ARMY AIR FORCES

### B. Birds—Continued.

#### 2. *Birds of prey:* (7 words)

Condor	Nighthawk	Sparrow	Vulture
Eagle	Owl	Hawk	

#### 3. *Marine birds:* (6 words)

Alabatross	Flamingo	Penguin	Sea Gull
Cormorant	Pelican		

### C. Fish.

#### 1. *Small Fish:* (11 words)

Catfish	Flying Fish	Sardine	Trout
Codfish	Halibut	Sea Bass	Whitefish
Flounder	Minnow	Sunfish	

#### 2. *Sea Monsters:* (6 words)

Octopus	Squid	Tuna Fish	Whale
Porpoise	Swordfish		

#### 3. *Shellfish:* (7 words)

Barnacle	Crab	Oyster	Snail
Clam	Lobster	Scallop	

## II—VEGETATION

### A. Flowers: (17 words)

Aster	Dandelion	Larkspur	M o r n i n g -
Buttercup	Geranium	Lilac	glory
Camellia	Goldenrod	Lily	Orchid
Carnation	Honeysuckle	Magnolia	Sunflower
Clover	Iris		

### B. Fruits: (15 words)

Apple	Blackberry	Huckleberry	Raspberry
Apricot	Blueberry	Lemon	Strawberry
Avocado	Cranberry	Lime	Watermelon
Banana	Grapefruit	Pineapple	

### C. Trees: (11 words)

Bamboo	Hickory	Olive	Walnut
Chestnut	Juniper	Pine	Willow
Coconut	Mahogany	Pistachio	



## RADIOTELEPHONE PROCEDURE

### D. Vegetables: (17 words)

Artichoke	Cucumber	Parsley	Rhubarb
Asparagus	Eggplant	Potato	Spinach
Cabbage	Mushroom	Pumpkin	Tomato
Cauliflower	Onion	Radish	Turnip
Celery			

## III—MINERALS

### A. Metals: (18 words)

Aluminum	Copper	Manganese	Potassium
Barium	Gold	Mercury	Radium
Calcium	Iron	Nickel	Silver
Chromium	Magnesium	Platinum	Sodium
Cobalt			Uranium

### B. Rocks: (13 words)

Alabaster	Crystal	Graphite	Lignite
Anthracite	Feldspar	Gravel	Limestone
Asphalt	Granite	Jasper	Marble
			Mica

### C. Precious stones: (12 words)

Agate	Bloodstone	Opal	Sapphire
Amber	Diamond	Pearl	Topaz
Aquamarine	Emerald	Ruby	Turquoise

## IV—BIBLICAL NAMES

### A. Proper names

#### 1. *Male*: (44 words)

Abel	Goliath	Jonah	Nimrod
Abraham	Hiram	Jonathan	Noah
Absalom	Hosea	Joshua	Obadiah
Adam	Isaac	Lazarus	Reuben
Agrippa	Isaiah	Matthew	Samuel
Andrew	Israel	Methuselah	Shadrach
Barnabas	Jacob	Mordecai	Solomon
Bartholomew	Jehoshaphat	Nebuchad- nezzar	Theophilus
Daniel	Jeremiah		Timothy
Elisha	Jerome	Nicodemus	Uriah
Ezekiel	Joab	Nicholas	Zechariah
Ezra			

# ARMY AIR FORCES

## A. Proper names—Continued.

### 2. *Female:* (11 words)

Abigail	Cecilia	Jezebel	Naomi
Barbara	Deborah	Magdelene	Rebecca
Beulah	Delilah	Martha	

## B. Books of Bible: (10 words)

Chronicles	Galatians	Lamenta-	Proverbs
Corinthians	Genesis	tions	Revelations
Ecclesiastes	Hebrews	Leviticus	

## V—AMERICAN COLLEGES

Barnard	Duke	Loyola	Stanford
Baylor	Duquesne	Marquette	Swarthmore
Bucknell	Fordham	Notre Dame	Vanderbilt
Colgate	Georgetown	Princeton	Villanova
Columbia	Harvard	Purdue	
Cornell	Holy Cross	Radcliffe	
Dartmouth	Johns Hopkins	Rutgers	

## VI—PRESIDENTS OF THE UNITED STATES (16 words)

Adams	Fillmore	Johnson	Roosevelt
Buchanan	Harding	Lincoln	Tyler
Cleveland	Hoover	McKinley	Van Buren
Coolidge	Jefferson	Monroe	Washington

## VII—AMERICAN INDIAN TRIBES (17 words)

Apache	Chickasaw	Eskimo	Pawnee
Aztec	Chincok	Huron	Seminole
Blackfeet	Chippewa	Iroquois	
Cherokee	Choctaw	Mohican	
Cheyenne	Comanche	Navaho	

## VIII—MUSICAL INSTRUMENTS

Accordion	Double-bass	Oboe	Trumpet
Bassoon	Guitar	Organ	Tuba
Bugle	Harmonica	Piano	Ukulele
Castanet	Harpsichord	Piccolo	Viola
Cello	Horn	Saxophone	Violin
Clarinet	Kettledrum	Tambourine	Xylophone
Cornet	Mandolin	Trombone	

**RADIOTELEPHONE PROCEDURE**

**IX—COLORS (14 words)**

Blue	Gray	Orange	Yellow
Brown	Indigo	Purple	White
Ebony	Lavender	Red	
Golden	Maroon	Vermillion	

**X—STARS AND CONSTELLATIONS (11 words)**

Big Dipper	Neptune	Pluto	Uranus
Jupiter	North Star	Sirius	Zodiac
Milky Way	Orion	Southern Cross	

**XI—TEXTILES (8 words)**

Alpaca	Corduroy	Gabardine	Rayon
Broadcloth	Flannel	Nylon	Wool



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[A. G. 300.7 (5-8-43).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,  
*Chief of Staff.*

OFFICIAL:

J. A. ULIO,  
*Major General,*  
*The Adjutant General.*

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(For explanation of symbols see FM 21-6.)









